SCIENCE IN SLOVENIA

overview with highlights

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Contents

PREFACE

SCIENTIFIC ENDEAVOUR IN SLOVENIA
- A HISTORICAL OVERVIEW 1

ORGANIZATION AND FINANCING 7

THE SLOVENIAN ACADEMY OF SCIENCES AND ARTS 11

SAZU Institutes 11

UNIVERSITIES 14

- University of Ljubljana 14
- University of Maribor 18

RESEARCH INSTITUTES 20

- The Jožef Stefan Institute - IJS 22
- Boris Kidrič Institute of Chemistry - KIBK 25
- Institute for Testing and Research in Materials and Structures - ZRMK 27
- Institute for Social Sciences 29
- The University Institute for Biology - IBU 30

RESEARCH FIELDS 32

NATURAL AND TECHNICAL SCIENCES 32

- Mathematics 32
- Physics 32
- Chemistry 35
- Metallurgy 40
- Computer Science, Informatics, Automation and Control 41
- Electronics 45
- Nuclear Engineering 46
- Mechanical Engineering 47

MEDICINE 48

AGRICULTURE AND BIOTECHNOLOGY 53

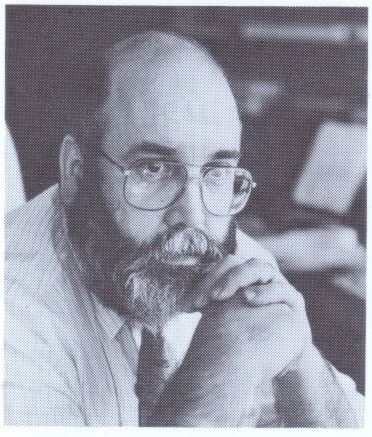
ECOLOGY 58

THE HUMANITIES AND THE SOCIAL SCIENCES 59

INTERNATIONAL LINKS 64

RESEARCH FACILITIES AND INFORMATION SYSTEMS .. 72


GERMANY
POLAND
CZECHOSLOVAKIA
AUSTRIA
SWITZERLAND
HUNGARY
SLOVENIA
CROATIA
ITALY
(YUGOSLAVIA)
ALBANIA
GREECE



PREFACE

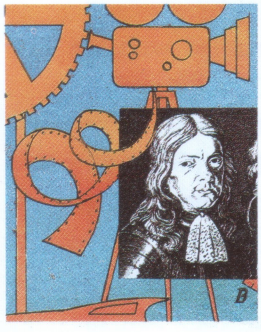
As we now ponder the future of the independent state of Slovenia, it is clear to us, that we must extend and maximize the comparative advantages of our scientific and research community. Freedom and democracy never come cheap but in addition to the now familiar goals of other East and Central European countries (market economy, privatization, development of both local and republic-wide, newly functioning democratic public institutions) we must both maintain the existing level of our scientific establishment and develop the basis for its future growth and expansion as the dominanting force for our future development. History, the nature and structure of our economy, and our geographical position have dictated the technologically oriented path our future development must take.

We have a number of outstanding research and educational institutions. It is our opinion that for our size and our location we have one of the most advanced technologically oriented research structures in the ex-communist countries of Eastern and Central Europe.

Even though existing conditions in the past did not allow the full internationalization of our scientific and research community to the extent possible, we expect to contribute our fair share to the development of a network of interactive associated professionals and institutions world-wide and specially in Europe.

P. Tavčar

SCIENTIFIC ENDEAVOUR IN SLOVENIA - A HISTORICAL OVERVIEW



Around the year 1000, "Text from Freising" was written - the earliest known Slovene and Slavonic document in Latin script. At the end of the 14th and beginning of the 15th century, the humanist movement in Slovenia began, giving rise to a whole range of great thinkers, who were active in European courts and universities such as: TOMAŽ PRELOKAR, a bishop and tutor of the future Holy Roman Emperor Maximilian I; BERNARD PREGER, Dean of Vienna University and author of a very successful Latin texbook with German annotation (about 30 editions); MATIJA HVALE, professor at Vienna University and a proponent of the universal philosophy of nature; ANDREJ PERLAH, Dean of Vienna University and a scholar of encyclopaedic knowledge. The diplomat, SIGISMUND HERBERSTEIN, from Vipava "revealed" to Europe in his travel book from Russia (1st edition 1549) that far little-known country, in the same way that Turkey was revealed in 1531 by BENEDIKT KURIPEČIČ from Gornji Grad. A later representative of humanism in Slovenia was Dr. SANCTORIO SANCTORI, a native of Koper who worked in Italy; he introduced precise measurements into medicine; chiefly of body temperature, and with his research of the digestive system he was also a forerunner of modern physiologists.

In the year 1490, mercury was discovered in Idrija, which became the second biggest mine of this liquid metal in the world (after Almaden in Spain). Its continuous 500 year production was a powerful stimulus to the development of science, medicine and technology not only in Slovenia, but also in the greater European contintent. In the first half of the 16th century, PARACELSUS visited Idrija, and was the first to start using mercury systematically as a medicine. In the second half of the 18th century, the physician JOHANN ANTON SCOPOLI from Tyrol and BALTHAZAR HACQUET from Brittany worked near the mine. Both of them described the mine in Idrija and its geological, technological and ecological properties in their works and passed onto Europe a knowledge of the peculiarities of Slovenia. FRANC ANTON STEINBERG tried to describe scientifically the operation of the mine as early as the first half of the 18th century.The Idrijan speleologist JOŽEF MRAK, also the designer of the well known flood dams, worked with Scopoli and Hacquet. In the second half of the 19th century, MARKO VICENC LIPOLD was particularly successful at combining science and technology in managing the mine; by introducing a modern geological approach to mining, he contributed to the advancement

of this science. After the Second World War, the tradition was carried on by the geologist IVAN MLAKAR, who through a precise scientific approach, mastered the extremely complicated Idrian deposit, and set up the internationally renowned and recognised "Idrian Geological School".

In the middle of the 16th century, Slovene literature started with the publication of Protestant works. This was followed by the Catholic counter reformation; in 1583 the Jesuits took over education and in the 17th century started to introduce the advanced study of theology as well as philosophy and law at the beginning of 18th century. At the same time as the development of a Slovene university evolved, the founding of the first scientific association in Slovenia took place in Ljubljana between 1688 and 1689. The year 1689 saw the publication of the momentous work, "The Glory of the Duchy of Carniolia" by the great scholar JANEZ VAJKARD VALVASOR, who in four thick and richly illustrated books described nature and life in the greater part of Slovenia and neighbouring countries; the author tried to bring together the entire contemporary knowledge of this part of Europe. Through his study of the complex mechanism of the intermittent Cerknica lake, Valvasor became a member of the Royal Society in London.

Janez Vajkard Valvazor

One of the personages, who towards the end of the 17th century made efforts to establish a Slovene Academy of Sciences was MARKO GERBEC, a physician of high international repute. In the year 1693, also thanks to him, the Academia Operosorum Labacensium was established; this academy tried to bring together the most creative contemporary thinkers. In the 18th century, the majority of the most prominent Slovene figures worked abroad: AUGUŠTIN HALLERSTEIN from Mengeš became the President of the Mathematical Board, astronomer and mandarin at the Chinese court in Peking; the universally accomplished ŽIGA POPOVIČ established oceanography as a science with his book "Essay on the Sea" (1750); the physician ANTON MARKO PLENČIČ in 1752 proposed the theory of microorganisms as the cause of infectious diseases; ANTON JANŠA studied apiculture - his complete doctrine of apiculture was published posthumously in 1775, the mathematician and ballistics expert JURIJ VEGA established ballistics as a scientific discipline and in the years 1783 to 1797 his tables of logarithms were published, the most used device for calculation until the mass introduction of electronic computers. The general mathematisation of science influenced philosopher AKANTRA MISLEJ, who in 1814 produced a universal philosophical-mathematical system.

Jurij Vega

The entrepreneur Baron ŽIGA ZOIS was the main figure in efforts during the Enlightenment period towards the end of 18th century in Slovenia; as a patron and inventor he promoted literary and scientific aspirations. Among other things he made possible the first ascent to Mount Triglav in 1778 and the first attempted flight in a hot air balloon in 1789. From his circle emerged ANTON TOMAŽ LINHART, the first Slovene dramatist and an early Slovene historian, and JERNEJ KOPITAR, who compiled the first scientific Grammar of the Slovene Language in 1809. At that time a surgeon, VINCENT KERN, was the most respected physician in Vienna; he was successful at treating post operative infections that were common in the pre-aseptic era.

During the years of French occupation (1809-1813), Ljubljana was the capital of the Province of Illyria; but this period was not long enough for the realisation of ambitious plans to reorganise the educational system and establish a university, which would include a medical faculty. In the following period conservative, reactionary tendencies prevailed around almost all of Europe - these left their mark on the Ljubljana Congress of the "Holy Alliance", which took place in 1821, when for a few days Ljubljana became the centre of Europe.


Josef Ressel

The beginning of the 19th century in Slovenia was marked by the introduction of steam power. In 1818, the first steam ship sailed from Trieste to Venice, and in 1819, the first industrial steam engine was set up in Trieste, followed by the first steam engine in Ljubljana in 1835; soon after, steam power was used in the Idrija mine. JOSEF RESSEL, an inventor of Czech-German origin, developed his idea for a ship's screw propeller while he worked in Ljubljana; he patented it in 1827, and was the first in the world to use it in civil navigation two years later in Trieste. The introduction of steam power reached its peak in Slovenia in 1849 and 1857, when the railway line from Vienna reached Ljubljana and Trieste respectively. In 1831, the National Museum was opened in Ljubljana. In 1842, JANEZ PUHAR excelled among the inventors with his glass plate photography.


Franc Miklošič

In 1830, a missionary and later bishop, FRIDERIK BARAGA, started to work among the Ottawa and Chipeewa Indians; he was an important researcher of ethnology and linguistics and the author of the first grammar book of one of the Indian languages. In 1850 another missionary, IGNACIJ KNOBLEHAR called Abuna Soliman, advanced 4100 km along the White Nile from the Nile Delta, the furthest reached by any contemporary explorer. In the years

1852-1975, FRANC MIKLOŠIČ wrote his life work, an extensive "Comparative Grammar of Slavonic Languages". In 1853, PETER KOZLER tried to define the ethnic borders of the Slovene counties. The Vienna geographer ADOLF SCHMIDL established in 1854 speleology as a new world science with his work on Slovene Karst caves.


Jožef Stefan

In 1879, JOŽEF STEFAN, the director of the Physics Institute in Vienna, discovered the law of radiation, the only law of natural science discovered by a Slovene. At the big international exhibition of electrical engineering in Vienna in 1883, Stefan was the head of the scientific board and laboratory, in which, with the help of the best contemporary equipment and top experts, he established the measurement of electricity - and thus the science of electrical engineering. The age of electricity started in Slovenia as early as the year 1880, when the first electric light bulb was switched on in Tržič; in 1884 the first public power station began to operate in Škofja Loka, and in 1888 a steam power generating station was also built in Ljubljana.

A devastating earthquake struck Ljubljana in 1895; this was followed by a renovation, planned according to the modern urban designs of the architect MAKS FABIANI. Two years after the earthquake, the professor of physics ALBIN BELAR established at the Ljubljana Polytechnic the first modern European earthquake monitoring system, one of the first in the world. In 1898 Baron ANTON CODELLI, a later pioneer in the introduction of long-range radio links (Africa-Europe) and inventor of a television system which was patented in 1928, brought the first car to Ljubljana. In 1901, Ljubljana acquired an electric tram and thus optimistically entered the 20th century. At that time a surgeon, EDO ŠLAJMER, a native of Croatia, with a professional reputation of being "the best surgeon in Vienna", in addition to being a determined reformer of operative medicine in Slovenia, was working in Ljubljana.


Fritz Pregl

An engineer, FRANC WELS, developed the world's first flying wing, based on the shape of a plant seed; with this aircraft he completed the first powerless flights in Austria-Hungary in 1906. At the end of 1929, EDVARD RUSJAN was the first to make a powered flight in Slovenia and this part of Europe. In 1911, IVAN SLOKAR was granted a patent for the invention of a powered aircraft with two revolving rotors instead of wings; but such an aircraft became technically feasible only 25 years later. In 1914, JULIJ NARDIN, a professor of physics at the Idrija Technical High School, was developing a patent application of an idea for a two-

stage rocket that would become a self-propelled torpedo in the sea and would operate according to a plan, printed on a perforated strip; thus Nardin was one of the first to introduce cybernetics to Slovenia. DAGOBERT MUELLER successfully tested his construction of a hovercraft in 1916 (literature cites the year 1955 as the year of this invention). At that time a physician, FRITZ PREGL, who worked in Graz, developed a micro-analysis technique for organic chemistry, for which he received the Nobel Prize in 1923 - thus far, the only Slovene scientist to receive it.

After the First World War, in 1919, the Slovene University was founded in Ljubljana. Some of the first university professors were at that time internationally renowned Slovene scientists. Among them were: JOSIP PLEMELJ, who became famous in 1906 by solving the Rieman's Problem of differential equations (many thought that it was an insolvable problem); the chemist MAKS SAMEC, who became famous through his discoveries in the chemistry of starch; his co-worker MARIUS REBEK, who later worked in Graz, where he devoted himself to the chemistry of cellulose and paper; the electrical engineer MILAN VIDMAR, a leading expert on transmission of electrical power and especially on transformers; and the architect JOŽE PLEČNIK, who began to shape Ljubljana into a "Slovene Athens" in the late twenties. In 1933, a skyscraper was built in the Slovene capital on anti-earthquake principles with a construction design by the architect VLADIMIR ŠUBIC; this was the highest contemporary residential building in Europe.


Josip Plemelj

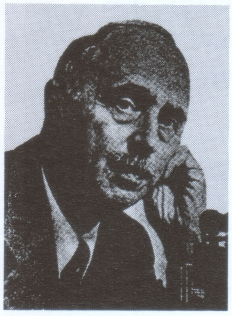
In 1929, HERMAN POTOČNIK-NOORDUNG wrote a book, entitled "The Problem of Space Travel", a textbook of a generation of space pioneers. Potočnik was also the first to calculate the elements of a geostationary satellite above the equator and also intended it to have a communication function. As early as in years 1923-1925, a marine officer MIROSLAV ŠTUMBERGER, developed a rocket motor driven by liquid fuel, at the same time as the most advanced efforts of this kind in the world were taking place.


Maks Samec

Among the contemporary physicists and technicians who led the way towards the new scientific era, were the electrical engineer VLADIMIR ŠLEBINGER, who successfully participated in adapting the cathode ray tube for television technology at the Hertz Institute in Berlin in the years 1930-1933; the electrical engineer VENČESLAV KOŽELJ, who dealt with the theory of electrical engineering; and the first Slovene nuclear physicist ELMER REBOLJ, who cooperated with Enrico Fermi. The mid 1930's marked the

major turning point in Slovenia's technological tradition, through works of the physicist ANTON KUHELJ, who started aircraft construction on a strict scientific basis.

In 1938, during the last years before World War II, the Slovene Academy of Sciences and Arts was founded in Ljubljana. The first president was an expert in Slovene language, RAJKO NAHTIGAL. Today, there are 66 regular members, whose president is JANEZ MILČINSKI, an internationally respected expert on medical law. Within the Academy is the Scientific Research Centre, comprising 13 Institutes. Many of the institutes have been named after some of the most reknown experts in their field. The Institute for the Slovene Language is named after FRAN RAMOVŠ, who was the greatest authority on the history of Slovene language. The Institute for History, is named after FRANC and MILKO KOS, who were the leading Slovene historians during the years 1882-1972. Milko Kos dedicated his central work to the question of the origin, migration and adaptation of Slovenes to Slovenija. The Institute of the History of Art is named after one of the greatest historians FRANCE STELE. The Institute of Geography was named after ANTON MELIK, whose extensive work "Slovenia" is still without equal. The Institute of Paleontology bears the name of its founder, geologist and paleontologist IVAN RAKOVEC. The Institute of Biology is named after JOVAN HADŽI, the proponent of a unique theory of the origin of species.

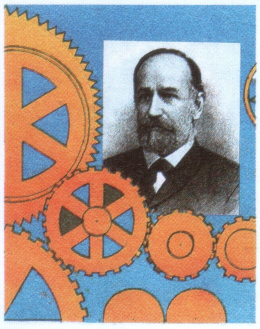


Jovan Hadži

ORGANIZATION AND FINANCING

Ministry of Science and Technology

Scientific research and development potential.



Minister:
Prof. Dr. Peter Tancig
Address: Titova 32
61000 Ljubljana
Tel.: 38-61 111-107
Fax: 38-61 302-131

There are over 9000 researchers in Slovenia. Thanks to Government funding of basic, applied and developmental research, there are some 4000 senior researchers engaged on projects, and a further 1400 younger scientists taking advantage of programme of financing postgraduate researchers.

This body of researchers works in 43 independent institutes (incorporating about 25% of the total research potential), 68 Faculties and Schools, at the Universities of Ljubljana and Maribor (about 37%), 30 University Clinics (about 8%), and in over 150 research and development departments, mainly in industry and production companies (about 30% of the research force).

During the past 10 years the number of researchers has almost doubled: the number of the PhD graduates increasing from 1100 to 1750, the MSc's from 650 to 1500. The training project for "young researchers" (i.e. postgraduate students) has greatly helped towards revitalizing research work. The average age of researchers has been brought down to 40, and one-fifth are younger than 29 years of age.

The table below shows the distribution of researchers according to educational level and fields of research:

	PhD	MSc	Graduate Students
Natural Sciences	456	302	313
Engineering-Technology	395	534	699
Medical Sciences	256	170	105
Agricultural Sciences	125	79	163
Social Sciences	315	257	129
Humanities	177	103	73
In Summary	1824	1445	1482

Note: mid-summer 1990 data

Financing Research and Development

For several years now, Slovenia has been financing the funding of research and development - with allowance for major fluctuations - approx. 1% of the Gross National Product, or between 80 and 120 million US $.

From the mid-70's, the share contributed from public funds rose from approx. 0.3% to approx. 0.8% in 1987, after which it began to drop. In the past 18 months, contributions from other sources have markedly decreased as a result of the current economic crisis which has led to the financial decline and increased insolvency of firms and companies. By far the greatest source of public funding is the state budget, while 3% of the funds are derived from the budgets of local administrations.

The table below illustrates the level of public funding, exclusively for the basic research programme, expressed in man-years (MY):

Year	1985	1986	1987	1988	1989	1990
MY	455	1100	1050	935	990	770

Overall, the public funds available for Research & Development (R&D) are distributed in the following proportions:

- basic research 40%
- applied research 16%
- R&D infrastructure (facilities) 14%
- education 30%

The policy of the Slovene government is to increase in its budget the percentage intended for R&D.

The Ministry of Science and Technology consists of the:

Division of R&D Programmes	Director: Dr. Miloš Komac
Division of Infrastructure and Operations	Director: Prof. Dr. Venčeslav Kaučič
Department of Informatics	Director: MSc. Iztok Tvrdy
Department of International Cooperation	Director: Miloš Kuret
Cabinet:	Chief: Alenka Kocjan

The Ministry also includes:

Director: Rudi Zorko
Tel: 38-61 302-947
Fax: 38-61 124-250

- **Standardization and Metrology Office** of the Republic of Slovenia,

Director:
Dr. Bojan Pretnar
Tel.: 38-61 302-951
Fax: 38-61 124-288

- **Industrial Property Protection Office** of the Republic of Slovenia.

Research Planning

The Parliament of the Republic of Slovenia is at present preparing a national research programme which, in accordance with the government's guidelines for development, will determine the focal-points for future research and allocate the necessary funds for financing these projects.

The Proposal for the National Research Programme, in conformity with Government requirements, has been drawn up by the Ministry of Science and Technology in collaboration with the Council for Science and Technology of the Republic of Slovenia.

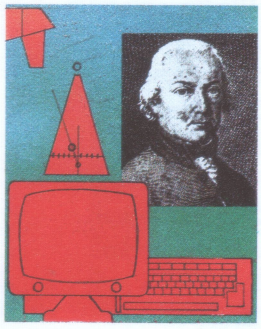
The research proposals and results are assessed by expert groups and evaluators, both Slovene and foreign, appointed by the Ministry. The Ministry also draws upon the additional expertise of economic institutes, commercial associations and development planning teams.

The focal-points of the R&D policy in Slovenia are:

- maintaining the high level of research activities,
- stimulating collaboration between research and industrial institutions,
- (co)financing and tax assistance for companies engaged in technical development plans and other applied research projects,
- research training and the further professional development of leading experts,
- close involvement in international research and development projects,
- establishing and operating facilities for the transfer of know-how.

The beautiful baroque Seminary Library is the oldest public library in Ljubljana. It was established in the early 18th century by the members of Academia Operosorum.

THE SLOVENIAN ACADEMY OF SCIENCES AND ARTS



President of SAZU: Academician Janez Milčinski
Address: Novi trg 5,
61000 Ljubljana
Tel 38-61 156-068
Fax: 38-61 155-232

The Slovenian Academy of Sciences and Arts (SAZU) has the oldest roots of all scientific institutions in Slovenia. Its origins can be traced back to the Jesuitic theological and philosophic schools of the sixteenth century. Today, SAZU has 66 regular members, 22 corresponding members and 85 external corresponding members from other Yugoslav Academies and Universities and many from scientific institutions abroad. The Slovenian Academy is active in different classes of research, including:

- history and the study of social classes,
- philosophy and social sciences,
- natural sciences,
- medical sciences,
- arts.

In every field of research there are close academic links with other academic institutions, particularly with the Austrian Academy and with the Royal Society in London. There are also links - to mention only the most outstanding ones - with the British Academy of Sciences, the Academy of Sciences USSR, the National Academy of Sciences Washington, the Academy of Science of the French Institute, etc.

The two most important projects of SAZU are: "Investigations into the Natural and Cultural Heritage of the Slovene Nation" and "The Study and Preservation of the Environment".


Missarum VII. & VIII. vocum, liber I.
SELECTIORES QVAE-
DAM MISSAE, PRO ECCLESIA DEI NON INVTI-
les, nunc primùm in lucem datæ ac correctæ
ab Authore
IACOBO HÀNDL.
Iacobo Gallo.
LIBRI TENOR. PRIMI
PRAGÆ
Ex Officina Typographica Georgii Nigrini.
Anno M. D. LXXX.

The front page of the "Selectiores Quaedam Missae" by Iacobus Gallus from 1580. SAZU has published a reprint of his monumental work in series Monumenta Artis Musicae Sloveniae.

Research Staff:
185 employees

The Research Centre of SAZU comprises 13 research institutes:

The Fran Ramovš Institute of Slovene	Director: Vladimir Nartnik
The Institute of Archaeology	Janez Dular
The Milko Kos Institute of History	Stane Granda
The France Stele Institute of Art History	Emilijan Cevc
The Institute of Musicology	Danilo Pokorn
The Institute of Slovene Literature and Literary Sciences	Darko Dolinar
The Institute of Slovene Ethnology	Julijan Strajnar
The Institute for Slovene Emigration Research	Andrej Vovko
Philosophical Institute	Rado Riha
The Anton Melik Institute of Geography	Drago Meze
The Ivan Rakovec Paleontological Institute	Dragica Turnšek
The Jovan Hadži Institute of Biology	Andrej Seliškar
The Institute for Karst Research	Andrej Kranjc
The Institute of Medical Sciences	A.O. Župančič

The seal of the Academia Operosorum, established in 1693 in Ljubljana.

The research is focused on the systematic investigations of Slovenian history, archeology and linguistics. It ranges from literature to music, ethnology, geography, paleontology and the geology of the Karst. Interdisciplinary fields of research are covered by various projects. A comprehensive data base from all the research fields is collected in the SAZU library, covering mainly the humanistic fields. This data have been the source material for various publications on Slovenian nature and culture. These works appear in encyclopedias and books or as periodical publications, which are also published by the SAZU.

Key works, published by SAZU:

- Dictionary of the Slovene Language I - V (1970-1991)
- Etymological Dictionary of the Slovene Language - 2 parts
- Map of Dialects, and various terminological dictionaries
- Archeological Sites in Slovenia - Archeologic Topography Monographs
- Encyclopedia of the Economic and Social History of Slovenia - 2 parts, the Historical Topography of Slovenia
- Monographs on the History of Art and the Topography of Art History in Slovenia
- Collection of Monumenta Artis Musicae Sloveniae - (15 volumes, including the new edition of the works of Petelin-Gallus)
- Slovenian Biographical Encyclopedia - 1925-1991- 15 Volumes
- Additional volumes in the collection of "Correspondence of Influential Slovenes and Older Scientific Critiques of Slovenian Literature"; Literature Encyclopedia (35 Volumes)
- Slovenian Folk Songs - 2 parts and several monographs
- Vegetation Map of Slovenia and Yugoslavia - Geomorphology Map
- "Slovenia" - various monographs in the field of Slovenian geography, paleontology and biology.

UNIVERSITIES

There are two universities in Slovenia: in Ljubljana and Maribor.

UNIVERSITY OF LJUBLJANA

Despite early beginnings of academic education in Slovenia, the University of Ljubljana was not formally established until 1919. The number of Faculties and Schools has considerably increased over the years, and nowadays, the University comprises 24 faculties (departments) listed below.

Rector:
Prof. Dr. Dušan Šket
13 Faculties
3 Academies
6 Colleges
789 Full and Associate Professors
495 Teaching Assistants
Address:
Kongresni trg 11,
61000 Ljubljana
Tel 38-61 154-055
Fax 38-61 154-053

The University of Ljubljana has more than 22,000 students. The University also offers a wide selection of different postgraduate studies as well as Master and PhD degrees in 248 fields. In the academic year 1989, for example, these resulted in 4,000 graduates from colleges and faculties in addition to 165 MSc and 62 PhD degrees. The University Faculties closely collaborate with the variously organized research institutes, such as the Jožef Stefan Institute, the Boris Kidrič Institute for Chemistry, the Institute for Biology, the Institutes for Geography, Mathematics, Physics, etc., where not only do the students perform research activities but also the University professors are engaged in research.

Centre for the Research and Development of University and the University Computer Centre were established due to the need to develop the University's information system, along with the computer processing of data, and to increase analytical research.

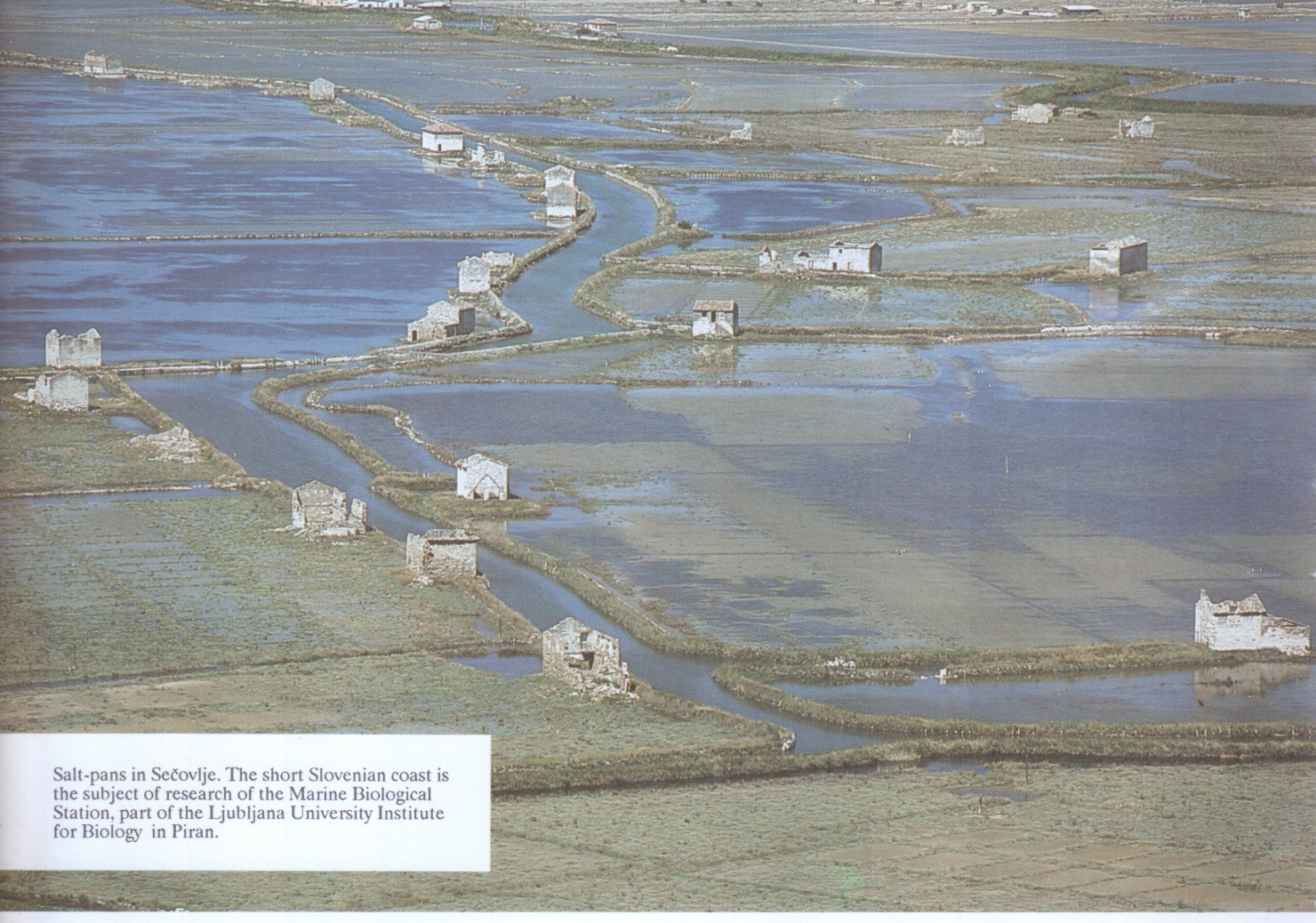
Because of the growing demand for postgraduate specialist education the University became engaged a few years ago in the programme of permanent scientific education known as "2000 Young Researchers", which is financed by the Government.

The University of Ljubljana has signed agreements on direct cooperation with about 25 universities all over the world. This collaboration comprises the exchange of university staff and students, scientific literature and other forms of scientific collaboration.

The University of Ljubljana includes faculties of natural sciences and technology as well as faculties of humanistic and social sciences in addition to the academies of arts. Over the past 40 years many former students of the University of Ljubljana have achieved high international recognition and professional awards in science and the arts.

Painted fronts of bee-hives are a Slovenian ethnological speciality. Anton Janša (1734-1773) is the founder of the scientifically based apiculture.

Faculty of Arts and Sciences	Dean: Prof. Marko Kerševan Aškerčeva 12, Ljubljana, Tel.: 38-61 150-001, Fax: 38-61 159-337
Faculty of Law	Dean: Prof. Dr. Lojze Ude Trg osvoboditve 11, Ljubljana, Tel.: 38-61 154-095 ,Fax: 154-095
Faculty of Economics	Dean: Prof. Dr. Vekoslav Potočnik Kardeljeva ploščad 17, Ljubljana, Tel.: 38-61 183-333, 345-669, Fax: 301-110
Faculty of Social Sciences	Dean: Prof. Dr. Slavko Splichal Kardeljeva ploščad 5, Ljubljana, Tel.: 38-61 181-461, Fax: 431-522
Faculty of Natural Sciences and Technology	Dean: Prof. Dr. Mitja Kregar Aškerčeva 9, Ljubljana, Tel.: 38-61 212-054, 212-005, 224-312 Fax: 38-61 224-312
Department of Mathematics and Mechanics	Head: Dr. Peter Legiša Jadranska 19, Ljubljana, Tel.: 38-61 265-061
Department of Physics	Head: Dr. Alojz Kodre Jadranska 19, Ljubljana, Tel.: 38-61 265-061, Fax: 217-281
Department of Chemistry and Chemical Technology	Head: Dr. Franc Lazarini Murnikova 6, Ljubljana, Tel.: 38-61 214-444
Department of Pharmacy	Head: Dr. Aleš Mrhar Aškerčeva 9, Ljubljana, Tel.: 38-61 221-078



Salt-pans in Sečovlje. The short Slovenian coast is the subject of research of the Marine Biological Station, part of the Ljubljana University Institute for Biology in Piran.

Department of Textile Technology	Head: Dr. Sonja Malej-Kveder Snežniška 5, Ljubljana, Tel.: 38-61 153-031, 153-009
Department of Geology, Mining and Metallurgy	Head: Dr. Jernej Pavšič Aškerčeva 20, Ljubljana, Tel.: 38-61 154-121
Department of Chemical Education and Informatics	Head: Dr. Metka Vrtačnik Vegova 4, Ljubljana, Tel.: 38-61 214-326 Fax: 38-61 226-170
Faculty of Electrical Engineering and Computer Science	Dean: Prof. Dr. Baldomir Zajc Tržaška 25, Ljubljana, Tel.: 38-61 265-161, 262-769 Fax: 38-61 264-990
Faculty of Mechanical Engineering	Dean: Prof. Dr. Peter Novak Murnikova 2, Ljubljana, Tel.: 38-61 218-252, 161-310 Fax: 38-61 218-567
School of Medicine	Dean: Prof. Dr. Mitja Bartenjev Vrazov trg 2, Ljubljana, Tel.: 38-61 312-669, Fax: 38-61 311-540
Faculty of Architecture, Building Engineering and Geodesy	Dean: Prof. Dr. Jože Koželj Jamova 2, Ljubljana, Tel.: 38-61 268-741, Fax: 38-61 268-572
Department of Architecture	Head: Prof.Ing. Peter Gabrijelčič Cojzova 5, Ljubljana, Tel.: 38-61 221-520, Fax: 38-61 221-520
Department of Building Engineering and Geodesy	Head: Prof. Dr. Florjan Vodopivec Jamova 2, Ljubljana, Tel.: 38-61 268-741, Fax: 38-61 268-572

Biotechnical Faculty	Dean: Prof. Dr. Jože Kovač Jamnikarjeva 101, Ljubljana, Tel.: 38-61 265-984, 264-761 Fax: 38-61 265-782
Department of Biology	Head: Prof. Dr. Andrej Martinčič Aškerčeva 12, Ljubljana, Tel.: 38-61 150-001
Department of Agronomy	Head: Prof. Dr. Franc Lobnik Jamnikarjeva 101, Ljubljana, Tel.: 38-61 264-761, 262-367 Fax: 38-61 261-073
Department of Food Technology	Head: Dr. Janez Hribar Jamnikarjeva 101, Ljubljana, Tel.: 38-61 273-092, Fax: 38-61 266-296
Department of Forestry	Head: Prof. Dr. Franc Gašperšič Večna pot 83, Ljubljana, Tel.: 38-61 271-170, Fax: 38-61 271-169
Department of Wood Technology	Head: Prof. Dr. Franc Bizjak Večna Pot 2, Ljubljana, Tel.: 38-61 272-172, Fax: 38-61 272-297
Department of Zootechnic	Head: Prof. Dr. Franc Habe Groblje 3, Domžale, Tel.: 38-61 713-611, 711-988 Fax: 38-61 721-005
Veterinary Faculty	Dean: Prof. Dr. Milan Pogačnik Gerbičeva 60, Ljubljana, Tel.: 38-61 159-063, 159-086 Fax: 38-61 218-005
Faculty of Sport	Dean: Prof. Dr. Franc Agrež Gortanova 22, Ljubljana, Tel.: 38-61 101-107, 101-391, 444-134 Fax: 38-61 448-148
Music Academy	Dean: Prof. Marjan Gabrijelčič Stari trg 34, Ljubljana, Tel.: 38-61 221-842
Academy of Theatre, Radio, Film and Television	Dean: Prof. Andrej Inkret Nazorjeva 3, Ljubljana, Tel.: 38-61 219-580, 210-412
Academy of Fine Arts	Dean: Prof. Dr. Tomaž Brejc Erjavčeva 23, Ljubljana, Tel.: 38-61 212-726, 219-071
Faculty of Pedagogy	Dean: Prof. Dr. Vinko Skalar Kardeljeva ploščad 16, Ljubljana, Tel.: 38-61 181-133, 347-998 Fax: 38-61 347-997
School of Social Work	Dean: Prof. Dr. Gabi Čačinovič-Vogrinčič Šaranovičeva 5, Ljubljana, Tel.: 38-61 311-132
Higher School for Health Workers	Dean: Miro Lubej Poljanska 26a, Ljubljana, Tel.: 38-61 316-597, Fax: 38-61 316-597
Higher Technical School of Safety Engineering	Dean: Dr. Vladimir Drusany Gorazdova 15, Ljubljana, Tel.: 38-61 558-251, 558-263
University College for Administration	Dean: Dr. Rudi Kocijančič Kardeljeva ploščad 5, Ljubljana, Tel.: 38-61 341-763
Maritime and Traffic School	Dean: Zdravko Klasek Pot pomorščakov 4, Portorož, Tel.: 38-66 73-390, 75-296, 75-675
Undergraduate School for Internal Affairs	Dean: MSc. Anton Goršek Kotnikova 8, Ljubljana, Tel.: 38-61 314-722, 311-975

University of Maribor Science Library.

UNIVERSITY OF MARIBOR

Rector:
Prof. Dr. Alojz Križman
3 Faculties
2 Collegess
114 Professors and
109 Assistant
Professors
Address:
Krekova 2
62000 Maribor
Tel 38-62 212-281
Fax: 38 62 23 151

The first institution of the present-day University in Maribor was the School of Economics and Commerce and the School of Technical Sciences, established in 1959, first with a two year programme and soon afterwards with a four year programme and postgraduate studies.

Today, 11,000 students are enrolled at the University of Maribor. The University has close connections with industry, educational, and cultural institutions, especially in the Štajerska (Styria) region of Slovenia. In spite of being relatively small, it has all the necessary facilities, of which special mention should be made of the recently built Computing Centre intended to provide Computing time and Information systems to the faculties. In addition, the Library, which has already been established in the city by the beginning of the century, was recently modernized and computerized, representing today an important cultural institution in Slovene Styria.

The University of Maribor comprises the following faculties and departments:

Faculty of Business Economics

Dean: Prof. Dr. Dušan Radonjič
Address: Razlagova ul. 14, 62000 Maribor,
Tel: 38-62 28-261, Fax: 38-62 27-056

with 11 Chairs with its own library and newspaper.
It is closely connected to:

School of Organization Science

Dean: Dr. Jože Florjančič
Address: Prešernova 11, 64000 Kranj,
Tel 38-64 212-834, 212-846
Fax: 38-64 214-458

Faculty of Technical Sciences

Dean: Dr. Valter Doleček
Address: Smetanova ul 17, 62000 Maribor,
Tel 38-62 25-461, 211-391
Fax: 38-62 212-013

Mechanical Engineering Department
Department of Electrical Engineering, Computer Science and Information Technology
Chemical Department
Civil Engineering Department

Faculty of Education

Dean: Prof. Dr. Jože Vauhnik
Address: Koroška cesta 10, 62000 Maribor,
Tel.: 38-62 211-297, 212-171, 27-961
Fax: 38-62 28-180

Faculty of Law

Dean: Prof. Dr. Miroslava Geč-Korošec
Address: Mladinska ul. 9, 62 000 Maribor,
Tel.: 38-62 27-876, Fax: 38-62 27-876

Agriculture College

Dean: MSc. Marjan Erjavec
Address: Vrbanska 30, 62000 Maribor
Tel.: 38-62 212-641, 212-653, 23-990
Fax: 38-62 23-363

RESEARCH INSTITUTES

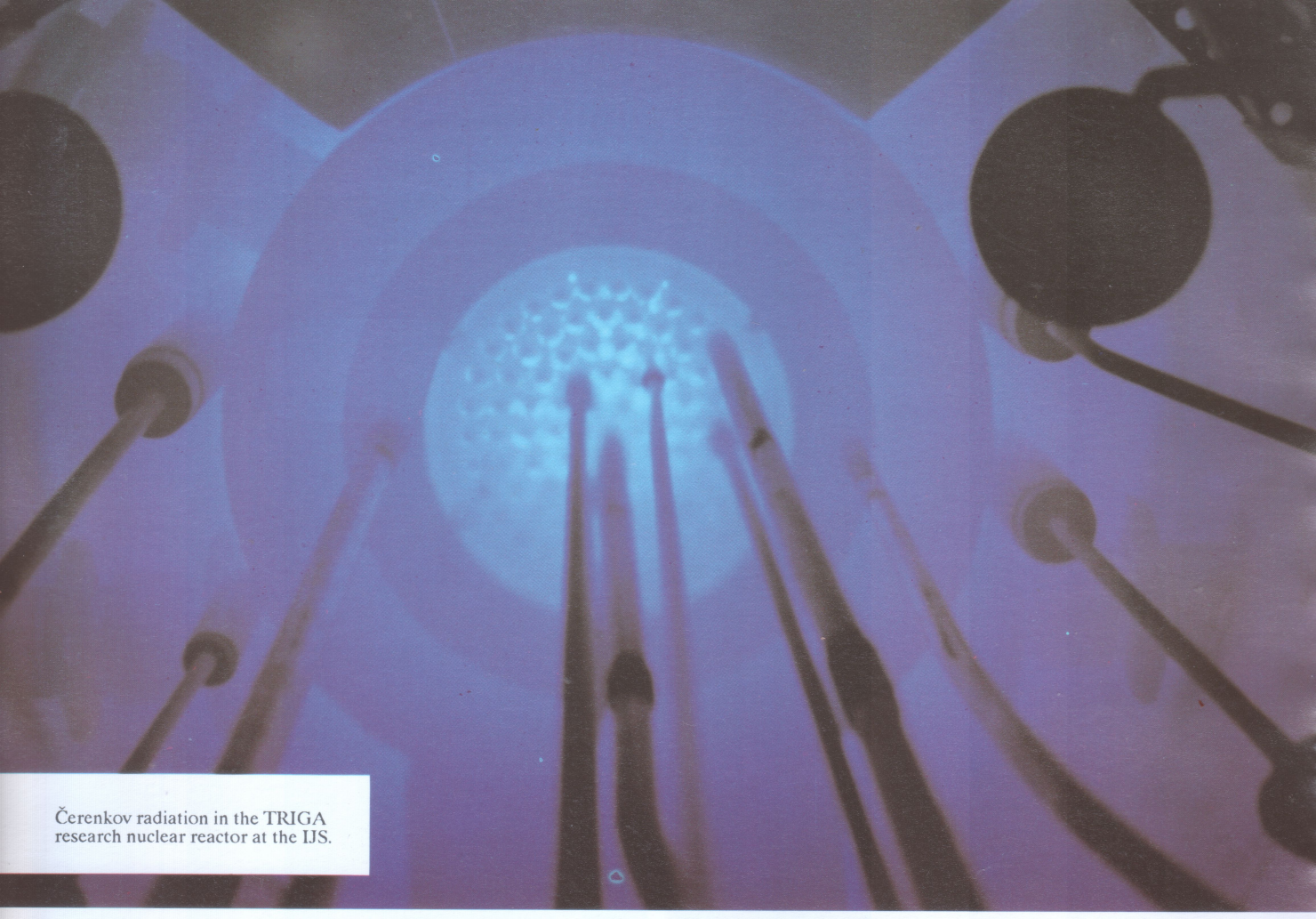
In Slovenia there are a number of research and development institutions, the major being (listed alphabetically):

Boris Kidrič Institute of Chemistry	Hajdrihova 2, 61000 Ljubljana Tel: 38-61-263-061, Fax: 38-61-263-385
Center for Economy Maribor	Razlagova 22, 62000 Maribor Tel:38-61-27-271
Centre for International Cooperation and Development	Kardeljeva pl.1, 61000 Ljubljana Tel: 38-61-347-591
Centre for Research and Development of University	Trg osvoboditve 15, 61 000 Ljubljana Tel: 38-61-213-316
Institute for Criminology at the Faculty of Law	Trg Osvoboditve 11, 61000 Ljubljana Tel: 38-61-331-820
Institute for Economy of the Faculty of Law	Prešernova 21, 61000 Ljubljana Tel: 38-61-221-688
Institute for Electronics and Vacuum Technology	Teslova 30, 61000 Ljubljana Tel: 38-61-267-341, Fax: 38-61- 263-098
Institute for Forest and Wood Economy	Večna pot 2, 61000 Ljubljana Tel: 38-61-268-963
Institute for Geodesy and Photogrammetry	Jamova 2, 61000 Ljubljana Tel: 38-61-268-861, Fax: 38-61-268-897
Institute for Geology	Dimičeva 14-16, 61000 Ljubljana Tel: 38-61-344-261, Fax: 38-61-371-557
Institute for Hop and Brewery	Žalskega Tabora 2, 63000 Žalec Tel: 38-63-711-221
Institute for Labour at the Faculty of Law	Trg osvoboditve 11, 61000 Ljubljana Tel: 61-38-213-471
Institute for Marketing, Economy and Organization	Kraigherjev trg 1, 61000 Ljubljana Tel: 38-61-314-477, Fax: 38-61-314-528
Institute for Mathematics, Physics and Mechanics	Jadranska 19, 61000 Ljubljana Tel: 38-61-265-061
Institute for Metal Constructions	Mencingerjeva 7, 61000 Ljubljana Tel: 38-61-332-023, Fax: 38-61- 219-437
Institute for Metallurgy	Lepi pot 11, 61000 Ljubljana Tel: 38-61-332-502, Fax: 38-61-213-780
Institute for Mining	Pražakova 8, 61000 Ljubljana Tel: 38-61-318-277 Fax: 38-61-314-873, 38-61-349-282
Institute for Pedagogy	Gerbičeva 62, 61000 Ljubljana Tel: 38-61-331-625
Institute for Public Administration at the Faculty of Law	Trg Osvoboditve 11, 61000 Ljubljana Tel: 38-61-311-855
Institute for Research in Economy	Kardeljeva pl. 17, 61000 Ljubljana Tel: 38-61-345-161, Fax: 38-61-342-760
Institute for Seizmology of the Republic of Slovenia	Kersnikova 3, 61000 Ljubljana Tel: 38-61-325-096
Institute for Social Sciences	Kardeljeva pl. 1 - 5, 61000 Ljubljana Tel: 38-61-341-511, Fax: 38-61-341-522
Institute for Testing and Research in Materials and Structures	Dimičeva 12, 61000 Ljubljana Tel: 38-61-183-261, Fax: 38-61-348-375
Institute for Textile Maribor	Kraljeviča Marka 21, 62000 Maribor Tel: 38-61-29-941, Fax: 38-62-29-991

Aerial infra-red pictures of forests damaged by the emissions from a lead mine (left) and a concrete factory (right). Research in ecology has already helped in diminishing industrial pollution.

photo by Geodetski zavod

Institute for Traffic of the Slovenian Railways	Moša Pijade 39, 61000 Ljubljana Tel: 38-61-313-044
Institute for Turbines	Rovšnikova 7, 61000 Ljubljana Tel: 38-61-51-522
Institute for Urban Development of the Republic of Slovenia	Jamova 19, 61000 Ljubljana Tel: 38-61-266-061, Fax: 38-61-262-873
Institute for Water Management	Hajdrihova 28, 61000 Ljubljana Tel: 38-61-210-812, Fax: 38-61-210-162
Institute for Welding	Ptujska 19, 61000 Ljubljana Tel: 38-61-346-061
Jožef Stefan Institute	Jamova 39, 61000 Ljubljana Tel: 38-61-159-199, Fax: 38-61-161-029
Milan Vidmar Institute for Electrical Engineering	Hajdrihova 2, 61000 Ljubljana Tel: 38-61-214-533
Pulp and Paper Institute	Bogošičeva 8, 61000 Ljubljana Tel: 38-61-211-192
Slovenian Institute for Agriculture	Hacquetova 2, 61000 Ljubljana Tel: 38-61-323-064, Fax: 38-61-323-057
University Institute of Biology	Karlovška 19, 61000 Ljubljana Tel: 38-61-211-744, Fax: 38-61-211-735
University Institute for Geography	Trg francoske revolucije, 61000 Ljubljana Tel: 38-61-213-458
Zoran Rant Institute	Kidričeva 66, 64220 Škofja Loka Tel: 38-64-631-251



Čerenkov radiation in the TRIGA research nuclear reactor at the IJS.

The Jožef Stefan Institute - IJS

Director:
Prof. Dr. Tomaž Kalin
Research Staff: 550
Address: Jamova 39,
61000 Ljubljana
Tel.: 38-61 159-199
Fax: 38-61 161-029

The J. Stefan Institute is a research organization for basic and applied research in natural sciences and technology. Both are closely interconnected in research departments composed of different task teams. Emphasis in basic research is given to the training and education of young scientists, while applied research and development serve for the transfer of advanced knowledge, contributing to the development of the national economy.

Due to its activities and national importance, the J. Stefan Institute, is the largest scientific organization in Slovenia, complementing the role of the universities and bridging the gap between science and its applications.

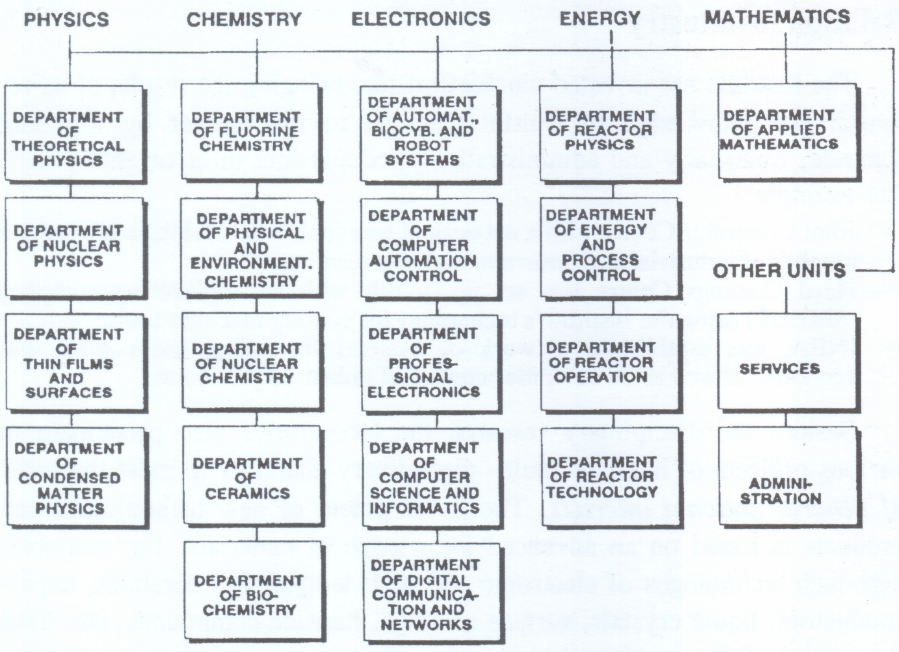
Historical Background

In the post World-War II period a number of institutes were founded in Slovenia, (e.g. for chemistry, electronics, electrical power, etc.) to work in science and in some fields considered important for national development. Among the others, the Institute for Physics was established within the Slovenian Academy of Sciences and Arts under the guidance of Prof. Dr. Anton Peterlin, later to become the J. Stefan Nuclear Institute. With time, however, as research spread over

to non-nuclear topics, and as the modest possibilities of developing domestic nuclear technologies were more realistically appreciated, the Institute became an independent research organization devoted to natural sciences and technology in general, as it is today, dealing with some fields of scientific and economic interest. After 40 years of successful work in scientific and other activities, the Institute has become a part of the image of Slovenia.

The basic philosophy and traditional ambition of the Institute is to contribute to the development of the country by providing top level scientific and applied output in the form of processes and products, as well as in the form of trained young scientists, both of which can only be achieved if based on high level of scientific research. Hence the Institute's polyvalent character, with strong links to the universities, other research institutions and industry.

The Institute* comprises several departments, covering five basic fields in the Natural Sciences:



Relation to the universities

Since its very beginning the Institute has been connected with the University of Ljubljana, to which it formally belongs, and later on also with the University of Maribor. Many Institute scientists, where they had the opportunity to develop their research talents, have later been appointed as professors while continuing their research or leading their research teams in the Institute. In all, 70 scientists are professors and 30 have temporary

*The brochure with detailed information is available.

teaching assignments at the Universities. They accept and supervise postgraduates for work on master's and/or doctor's theses, as required for the degrees to be conferred by the Universities. In the 40 years of the Institute's existence, more than 1200 theses of undergraduate students, about 400 master's theses and 300 doctor's theses have been completed/awarded within the institute's research programme, the degrees being conferred by the respective universities.

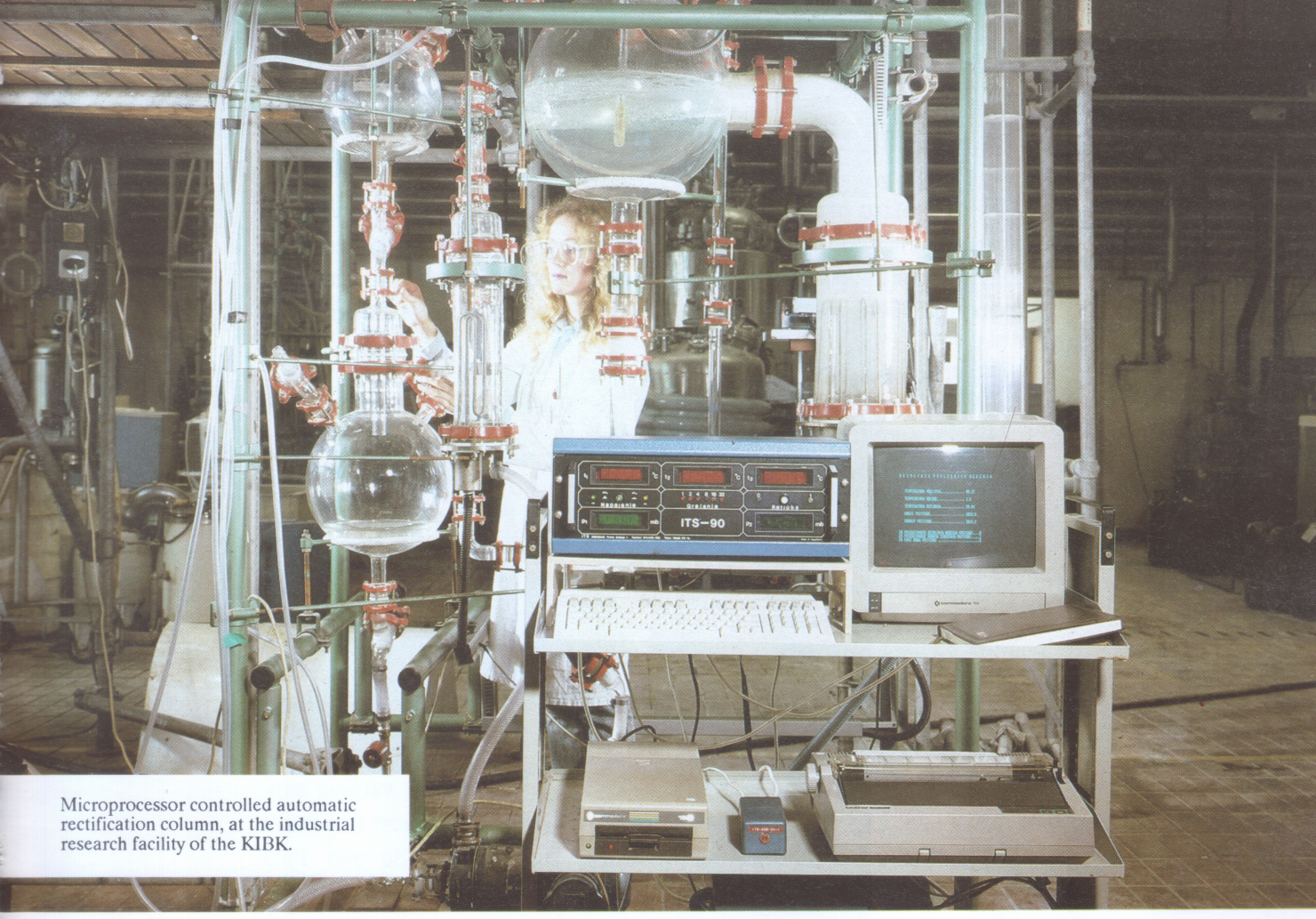
The laboratories at the Institute, thanks to their size and expertize, are better able, than most university (or industrial) groups in Slovenia to tackle demanding problems or large projects. They are fully open to university research groups and other users, and have, on average, more equipment than is available elsewhere. Thus, in some areas, they offer the only possibility in Slovenia to do advanced research, scientific or applied, thereby providing an indispensable complement to the universities.

Relation to industry

The Institute has invested much effort into bringing the results of its research and knowledge to fruitful use and to the market by founding separate, financially and administratively independent units or enterprises. For example:

- Joint Computer Centre with a network of terminals was established to serve a number of industrial and governmental organizations.
- Hard Coatings Centre was set up, jointly with an engineering company (SMELT) using the Institute's technology for coating machine-tools.
- INEA, was established to work on systems for energy-use control and economy, as well as on computer control of industrial processes.

Besides the disciplinary research the laboratories also participate in various projects of inter- or multi- disciplinary character to meet the ***tasks of general national interests***. The development of new technologies and products is based on an advanced knowledge of materials. For example, high-tech technologes of electronic and high temperature ceramics, superconductors, liquid crystals, surface coatings, fluoride compounds, etc. have been successfully transferred to industry. Optimization of energy consumption, control and consulting on energy problems in industry, based on modern computing methods, is carried out in collaboration with other institutes. Also, since the very beginning of nuclear energy, the safety of nuclear facilities has been considered of vital importance. Other important multi-disciplinary projects include environmental measurements and consulting, improvement of existing and development of nonpolluting technologies, automation, robotics and information sciences. Various close collaboration with University Clinical Centre resulted in the development of medical equipment (tomography, betatron, electrical stimulators and appliances), provided the isotopes for clinical research and patients treatment and introduced new research techniques and diagnostic methods in clinics.



Microprocessor controlled automatic rectification column, at the industrial research facility of the KIBK.

Boris Kidrič Institute of Chemistry - KIBK

The Boris Kidrič Institute of Chemistry is a non-profit research organization for basic and applied research in the field of chemistry and related scientific and technical disciplines, and also training of postgraduate students in research. Many Institute's researchers also are lecturers at the University of Ljubljana.

Director:
Prof.Dr. Stane Pejovnik
Research Staff: 170
Address: Hajdrihova 19
Ljubljana
Tel.: 38-61 263-061
Fax: 38 61 263-285

Historical Background

The Institute was officially constituted in 1946 as a Chemical laboratory of the Slovenian Academy of Science and Arts. Its principal task was initiation of new industrial programmes in the country. Important extension of the Insitute's activities occurred after 1953, when the Slovenian government and the University became its founders. A further consolidation of the Institute began in the seventies, when the government's founder rights were transferred to the Consortium of Slovenian Chemical Industry. At that time the predominantly short-term tasks were transformed into long-term ones. This was also a period of intensified cooperation with industry, the University and other research institutions, especially the Jožef Stefan Institute. Today the Institute works as an independent research organization.

The activities of the Boris Kidrič Institute* are divided into five main programmes entitled: Theoretical Chemistry, Analytical Chemistry and Ecology, Organic and Inorganic Materials, Biotechnology and Chemical Engineering. There are 10 individual research groups and/or departments for:

- Theoretical Chemistry,
- Analytical Chemistry,
- Polymer Chemistry and Technology,
- Chemistry, Biology and Waste Technology,
- Catalysis,
- Inorganic Chemistry,
- Food Chemistry and Technology,
- Biotechnology,
- Chemical Engineering,
- Organic Synthesis

There exist numerous mutual joint projects with foreign institutions, visits, guest invited lecturers, etc.

In addition to the basic scientific tasks, described above, various supplementary activities take place at the Institute. Among the most important are the projects for the Slovene industry, supporting MSc and PhD programmes at the universities, organization of experts' meetings, elaboration of expertise, attesting of raw materials, ecological research, elaboration of pre-investment documentation etc.

The Institute maintains a library containing 14000 books and 140 international scientific journals.

* A brochure with detailed information is available.

Institute for Testing and Research in Materials and Structures - ZRMK

Director:
Boris Gostič
Research Staff: 30
Address: Dimičeva 12
Ljubljana
Tel.: 38-61 182-014
Fax: 38 61 348-375

The Institute for Testing and Research in Materials and Structures was established in 1952 by the Government of the Republic of Slovenia.

About two-thirds of ZRMK's capacities are engaged in the quality control of materials, products and structures, testing and research work in cooperation with industry, the preparation of studies for engineering regulations and construction research equipment. The remainder of the capacities are involved in scientific and research work, which is financed directly by the industry, the Ministry of Science and Technology, and international funds such as the Yugoslav-American joint projects. ZRMK uses its own funds to pay for the training of its employees, and for the purchase and maintenance of its research equipment. Most of the PhD staff also teach at the Universities of Ljubljana and Maribor, and practical research programmes are carried out at the Institute.

ZRMK constists of three divisions, which are linked together by the Administration Office and Support Services. These divisions are:

- **The Institute for Structure, Building Physics and Restoration**
  Director: Vladimir Demšar
  Tel.: 38-61 182-014, Fax: 38-61 348-375
- **The Institute for Materials Research**
  Director: MSc Gojmir Černe
  Tel.: 38-61 182-014, Fax: 38-61 348-363
- **The Institute for Geotechnics and Roads**
  Director: Dr. Andrej Zajc
  Tel.: 38-61 182-014, Fax: 38-61 348-369

Research in the fields of structure, building physics and restoration is divided among different projects, some of which are listed below:

- **Masonry structures and earthquake engineering (projects:)**
  - In-plane Behaviour of Masonry Walls Subjected to Seismic Actions
  - The Influence of Rigidity of Floors on the Seismic Resistance of Old Masonry Buildings
  - Shaking Table Study of Masonry Building Models with Different Structural Configurations
  - Study of Methods for the Grouting of Stone-Masonry Walls
  - Study of the Seismic Vulnerability of Masonry Buildings
- **Reinforced concrete structures**
  - Study of the Seismic Behaviour of Repaired and Strengthened Masonry in Filled Reinforced-concrete Frames

Thermovision image of a wall, indicating heat losses. ZRMK projects aim at improving the energy efficiency of buildings.

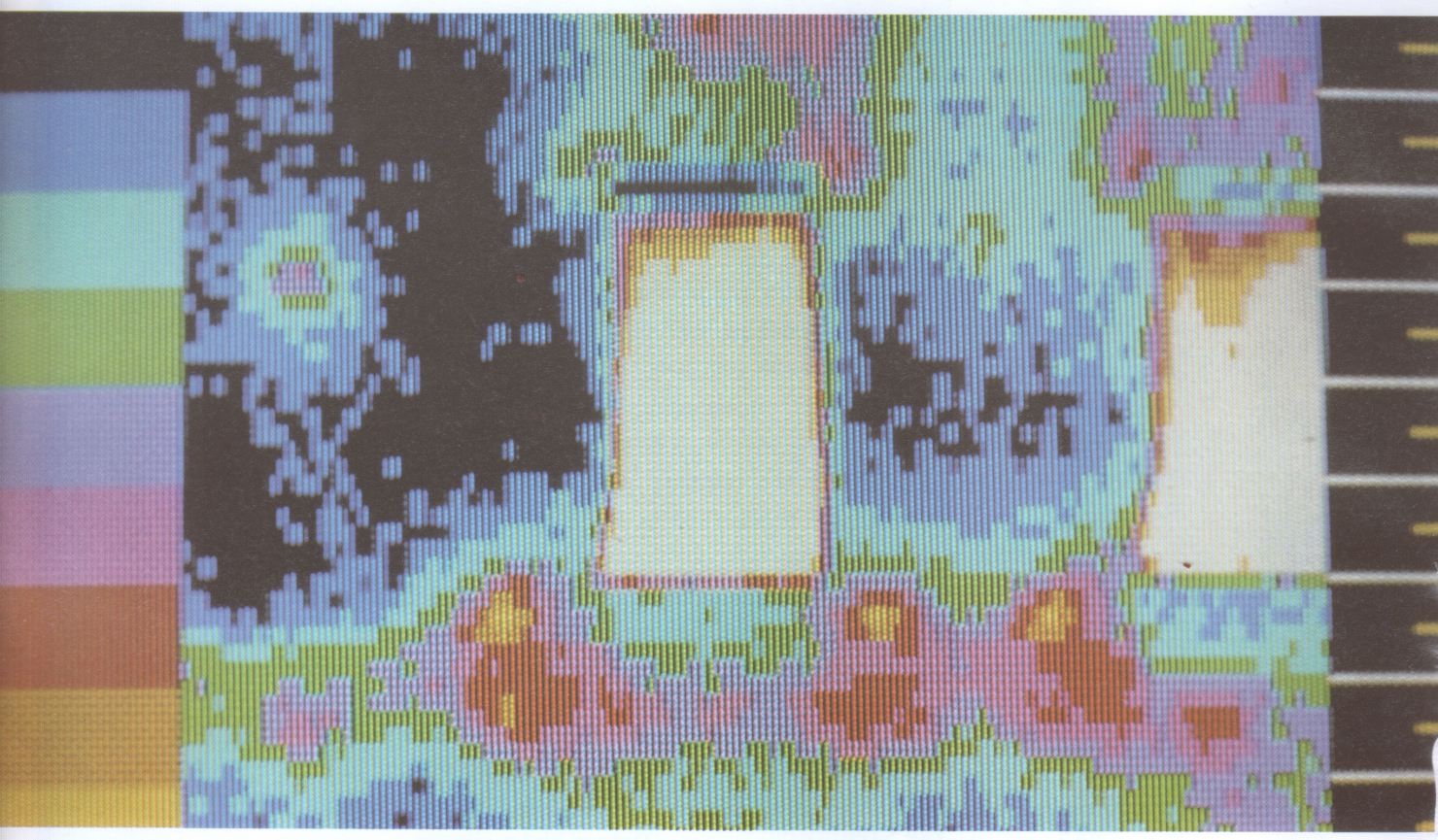


photo by ZRMK

- **Timber structures**

  Curved Glulam Beams in Changing Relative Humidity Conditions

- **Metal structures**

  Load-bearing Properties of Sandwich Elements Made of Metal Covers with Mineral Wool Filling

- **Bridge structures**

  Evaluation of the Load-carrying Capacity of Existing Bridges

- **Building physics - internal environment**

  Thermal Insulation of Existing Buildings and Possibilities for Improvements

  Systems of Transparent Thermal Insulation for Buildings

  Functional and Technical Standards for the Design of Residential Buildings

  Energy-saving Construction Design

  Technical Basis for the Development of Fire in Building Regulations

  Investigations into the Accoustic Properties of Means for Providing Protection against Traffic Noise

  Remedial Treatment for Dampness of Buildings

  Computer Aided Design and Analysis in Composite Materials

Institute for Social Sciences

Faculty of Social Sciences
Institute for Social Sciences
Head:
Dr. Vojko Antončič
Research Staff: 65
Address:
Kardeljeva ploščad 1, 5
61000 Ljubljana
Tel.: 38-61 181-461
Fax: 38-61 341-522

The Institute for Social Sciences was founded at the begining of 1991 by a merger of the Institute for Sociology (founded in 1959) and the Research Institute of the Faculty of Sociology, Political Sciences and Journalism (founded in 1976).

The 12 Research centres of the Institute deal mainly with the following topics:

- public opinion polls, international migrations, social stratification and social structure,
- economic, institutional, political and cultural determinants and consequences of communication in society (both nationally and internationally), political propaganda and advertising in the media,
- spatio-social structures and processes, policy and planning at the local level,
- theoretical and methodological problems of political science, the history of modern political thought and contemporary political ideas, political culture and comparative research of politics,
- theoretical problems of the right to self-determination of peoples and its application in different countries: theoretical, legal and political problems of international protection of minorities, socio-political processes in developing countries, contemporary regionalism,
- unclassified research in the area of national defense studies,
- theoretical and empirical research of religion and culture,
- role of science in the development strategy of Slovenia, social reproduction of knowledge, development of science and technology,
- social welfare, social justice and social policy, labour market and employment policy, modernisation processes,
- philosophic studies and studies in theoretical psychoanalysis,
- research methodology (research design, sampling and data analysis methods).

Main empirical research projects (data programmes) are:

- Quality of Life and Social Stratification Survey, Public Opinion Survey,
- Labour Force Survey.

The Institute is involved in several international research projects and occasionally organizes international conferences and workshops.

Daphne Blagayana, the best known plant of the Slovene flora was first described in 1837 by the botanist Freyer and named after the owner of the place where it has been found.

photo by Dr. Ravnik

The University Institute for Biology -IBU

Director:
Prof. Dr. Andrej Čokl
Research Staff: 26
Address: Karlovška 19
Ljubljana
Tel.: 38 61 211-744
Fax: 38- 61 211-735

The IBU comprises various laboratories, the botanical garden, the Marine Biological Station in Piran, and Limnologic Station in Bled. It was established in 1961 as an independent research institution by the University of Ljubljana, with the purpose of:

- promoting knowledge in basic biological processes,
- ecology of Slovenia,
- practical application of research in ecology,
- education and postgraduate studies,
- biology information systems - library and data base.

Several topics are investigated in the basic biology research programme:

The taxonomy and phylogeny programme collects the information on the flora and fauna of Slovenia and also, comparatively, that of the neighbouring countries. The major emphasis is on biological care for the species threatened by pollution. Practical application of this research in agronomy, pharmaceutical research, forestry and pisciculture, etc. is of great importance for Slovene agriculture and ecology.

Zelenci - the source of the river Sava. Monitoring the quality of water in Slovenia is included in several ecology programmes.

The anatomy, biochemistry and physiology programmes are oriented towards a structure-function relationship with application in tissue culture, and with the major goal of raising non-infected plant species.

The neurobiology of the sensor system in insects is studied at cellular and molecular levels. Research on wood damage due to air pollution is oriented towards defining the "anthropogenic" influences in wood ecosystems in order to take preventive measures and save this precious natural resource. For example, cytogenetic bioindication is used to diagnose the effects of pollutants on the mitotic activities in the roots of pine trees.

RESEARCH FIELDS

NATURAL AND TECHNICAL SCIENCES

MATHEMATICS

Director:
Prof. Dr. Jernej Kozak
Address:
Jadranska cesta 19,
61000 Ljubljana,
Tel.: 38-61 265-061
Fax: 38-61 217-281

Research in mathematics in Slovenia has its roots in several prominent Slovenian mathematicians (Jurij Vega, Josip Plemelj, Ivan Vidav). Today the mathematical research community numbers over 50 scientists, who are associated in their research activities with the Institute for ***Mathematics, Physics and Astronomy*** - IMFM, where the Mathematical Library is also located. Major fields of research are:

- analysis,
- topology,
- numerical and computer mathematics,
- algebra and foundations of mathematics,
- graph theory,
- statistics and probability theory.

Head:
Prof. Dr. Marjan Ribarič
Research Staff: 4

The Department of ***Applied Mathematics*** at Jožef Stefan Institute is involved in research into methods in computer science. They are studying numerical and statistical methods for solving scientific problems by computer, preparing software and providing teaching and training for a wide spectrum of computer users in various branches of application in science, statistics, economics and business.

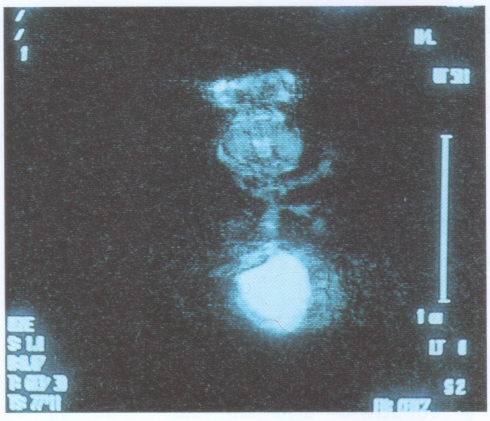
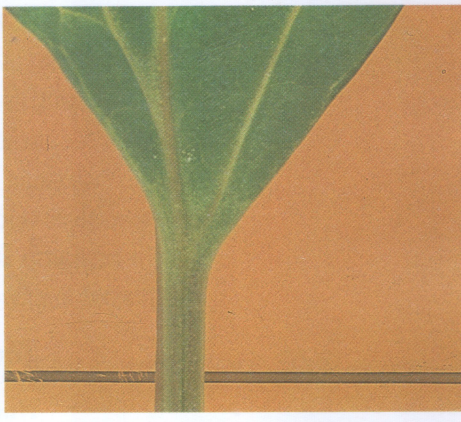
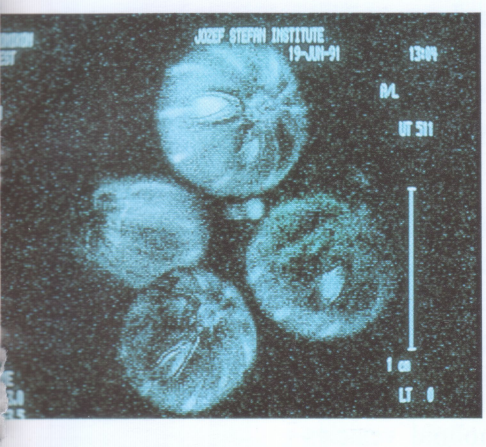
PHYSICS

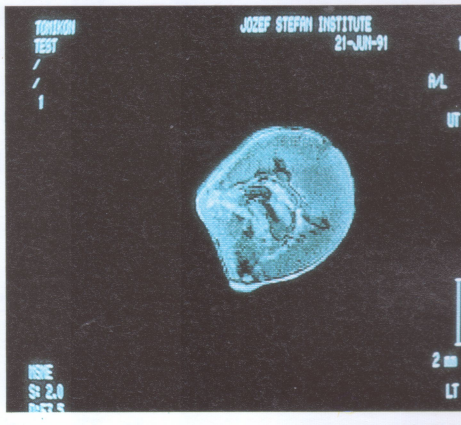
The major part of the research in physics in Slovenia is performed at the ***Jožef Stefan Institute***.

Head:
Dr. Rafael Martinčič
Research Staff: 43

Experimental Nuclear Physics has moved mostly from low energies (betatron 31 MeV, VdGraaf 2 MeV) to particle physics, atomic physic and analytical application (PIXE, X-ray fluorescence), while the supporting electronics, besides serving scientific research, also deals with measuring, regulation and automation for other (ecological, industrial) purposes. A good part of experimental work is done at research centres with big facilities (accelerators) such as CERN (Geneva), DESY (Hamburg), KFA (Jülich) and universities (Mainz, Uppsala) by contributing to the development and construction of detection systems and detectors or by evaluating results and experiments.

Research done by the Reactor Engineering Department at IJS in the field of structural analysis is represented by computer aided tube crack opening analysis by the finite element method.

Head:
Academician
Robert Blinc
Research Staff: 53

Condensed Matter Physics incorporates a number of laboratories dealing with NMR, EPR and electron microscopy methods and uses. The main research activities are:

- nuclear and electron magnetic resonances,
- liquid crystals,
- ferroelectrics, phase transitions,
- proton glasses,
- incommensurate systems,
- biopolymers and membranes,
- quantum optics,
- molecular electronics,
- thin films and defects in crystals,
- transport of molecules through membranes,
- high T_c superconductors.

Applied research is done particularly on liquid crystals, ferroelectric materials, and NMR, some of it (LC displays, thin films and solid state sensors, optical microlithography) in the Centre for Natural Sciences and Technologies established for the transfer of research results into industrial applications.

Head:
Prof. Dr. Boris Navinšek
Research Staff: 5

Thin Films and Surfaces research is involved in ion and plasma interactions with solid surfaces and multilayered structures, and is developing processes and applications of thin film and hard coating technologies. Work on surface - plasma interactions is connected to some European Community projects, while hard coating research is done in cooperation with universities in Mainz, Stuttgart and Kaiserslantern. The main research interest is on TiN, ZrN as well as on Y-Ba-Cu-O films and sputtered surfaces.

Head:
Prof.Dr.Peter Prelovšek
Research Staff: 24

Theoretical physics is done in several areas:

Nuclear reactions and nuclear structure via a microscopic theory involving three clusters, the equation of state of a quark gas at high pressure and tempe-rature in the chiral chromodynamic model, and substructure of quarks and leptons. Also diagnostic tools are developed to test the consistency of Feynman rules in Quantum Chromodynamics, when quantized in a physical gauge.

Theoretical ***Solid State Physics*** research has been during recent years devoted mainly to: mechanisms and models of high-temperature superconductivity, strongly correlated electrons and the phase transitions in various systems such as spin glasses, random systems, ferroelectric and nematic liquid crystals, incommensurate structures and metallic surfaces.

In ***Theoretical Biophysics***, the membranes, the phospholipid vesicles and cells are studied. In particular, forces between charged surfaces and shapes of cells are investigated in order to understand the membrane equilibrium properties.

Applied Physics

ISKRA,
Electrooptics
Director:
MSc. Jože Žakelj
Employees:: 500
Address:
Stegne 7, Ljubljana
Tel.:191-215, 576-982
Fax: 38 61 575-985

A large R & D group is active at ***ISKRA***, Centre for ***Electrooptics,*** whose activities are centred on the development of lasers and their application in measurements and communications. Some recent achievement of this group are: development of a complete thermovision system, laser application in medicine and fibre optics communication systems.

CHEMISTRY

Chemistry is the field of science in which Slovenia entered the world history through the only Slovenian Nobel prize-winning scientist, Fritz Pregl, who was awarded the prize in 1923 for the development of microanalysis techniques.

Head:
Prof. Dr. Boris Žemva
Research Staff: 16

At the ***Jožef Stefan Institute*** the main research fields studied are in inorganic chemistry and chemical technology, inorganic ***Fluorine Chemistry***, synthesis and characterization of new binary and complex compounds. Further study-areas include:

- chemistry of high energy oxidizers (KrF_2, O_2F_2, F_2, xenon fluorides) and achievement of unusual high oxidation states,
- chemical processes under extreme and unusual conditions (high pressure, supercritical solvents etc.),
- synthesis of inorganic compounds with special physical or chemical properties,
- synthesis of new, ecologically more acceptable (FC-s etc.).

The research interest of this group extends to several industrial applications.

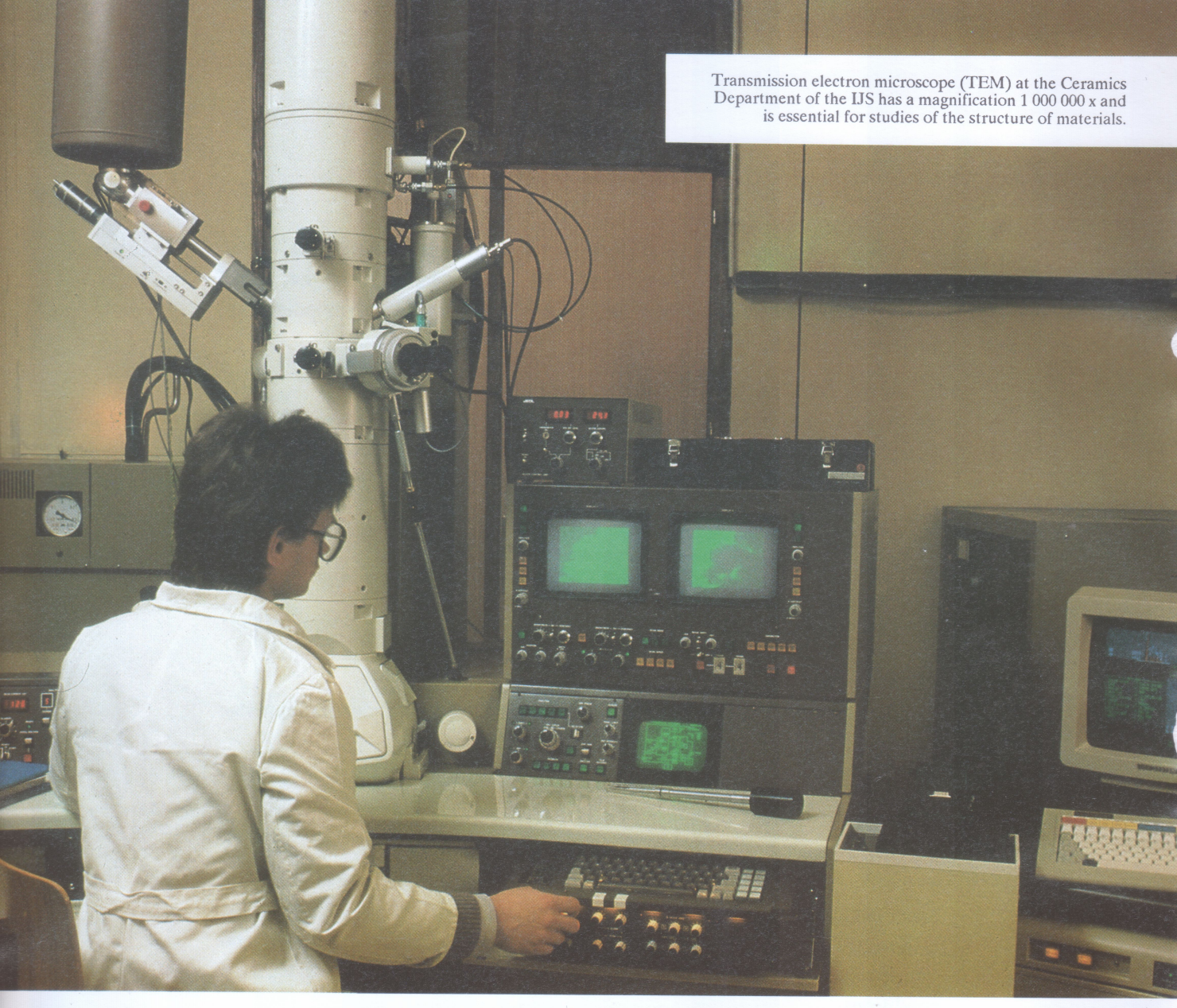
Head:
Prof. Dr. Drago Kolar
Research Staff: 29

Ceramics research at the IJS is involved in synthesis and the properties of systems of the type PbO - F_2O_3 - Nb_2O_5 and similar, exhibiting outstanding dielectric properties and low sintering temperatures. Other types with priezoceramics properties, hard magnetic materials and high temperature superconductors are also being studied. The laboratory is fully equipped for materials characterization (scanning and transmission electron microscopy etc.) and synthesis under most variable conditions.

Industrial applications developed in the laboratory include Li-Al glasses, hydrogen storing ceramics, and particularly materials for electronics (ceramic substrates, hybrid and multilayer components, ferritic and magnetic materials), as well as compositers, cutting materials and similar. The extent of industrial cooperation makes the laboratory virtually an indispensable research and development place for most local industries of special materials.

Head: Dr. Ivan Kobal
Research Staff: 33

In ***Physical Chemistry and Environmental Chemistry*** Department *ab initio* quantum mechanical calculations for kinetic isotope effects are carried out to interpret reaction path, transition states and reaction mechanism, as well as the properties of crystals and physico-chemical phenomena at their surfaces. In solution chemistry, some basic physico-chemical properties of associated mixtures of a polar or non-polar solute with or without a protic solute in a polar or non-polar solvent are studied.



Transmission electron microscope (TEM) at the Ceramics Department of the IJS has a magnification 1 000 000 x and is essential for studies of the structure of materials.

Adsorption of anions on monodispersed colloidal particles in electrolyte suspensions is interpreted according to the electric double and triple layer model. Analytical and radioanalytical methods are developed to be used in ecology and radioecology.

Faculty of Natural Sciences and Technology, Laboratory for Physical Chemistry
Head:
Prof. Dr. Gorazd Vesnauer
Research Staff: 20
Address: Snežniška 5
Ljubljana
Tel.: 38-61 224-215

The research work is conducted mainly in the field of electrolyte, colloid, polyelectrolyte and biopolymer solutions. Various thermodynamic and transport properties are invstigated theoretically based on the classical electrostatic theories as well as on statistical mechanics. Experimentally, powerful techniques such as microcalorimetry (batch, flow, titration), DSC, UV and fluoroscence spectrometry, vibrating tube densitometry, vapor pressure and membrane osmometry, potentiometry, etc. some are used.

Head: Dr. Ivan Kobal
Research Staff: 33

The ***Mass Spectroscopy*** Laboratory at the IJS works in organic mass spectrometry, isotopic geochemistry and some organic synthesis. MS/MS technique has been used to study several types of organic compounds. Unimolecular and collisionally activated ion fragmentation reactions were performed to characterize ion structures. The reactions of fluoroxysulphate ($CsSO_4$) with several organic compounds under various reaction conditions have been studied. In addition, two new reagents for selective bromination of aromatic compounds have been prepared.

Head:
Prof. Dr. Peter Stegnar
Research Staff: 20

Nuclear Chemistry is mainly concerned with the environment and the research is focused on the development and use of analytical methods, and radiochemical or radiometric procedures. Neutron activation analysis, both in its radiochemical form and its instrumental mode, allows for simultaneous multielement analysis and measurements of total elemental concentrations of a wide range of elements in a variety of samples.

The measurement of the content and distribution of radionuclides, both natural and man-made, is based on both instrumental gamma spectrometry, and various radiochemical methods. Application of these includes monitoring around the Žirovski Vrh Uranium Mine and the Krško Nuclear Power Plant.

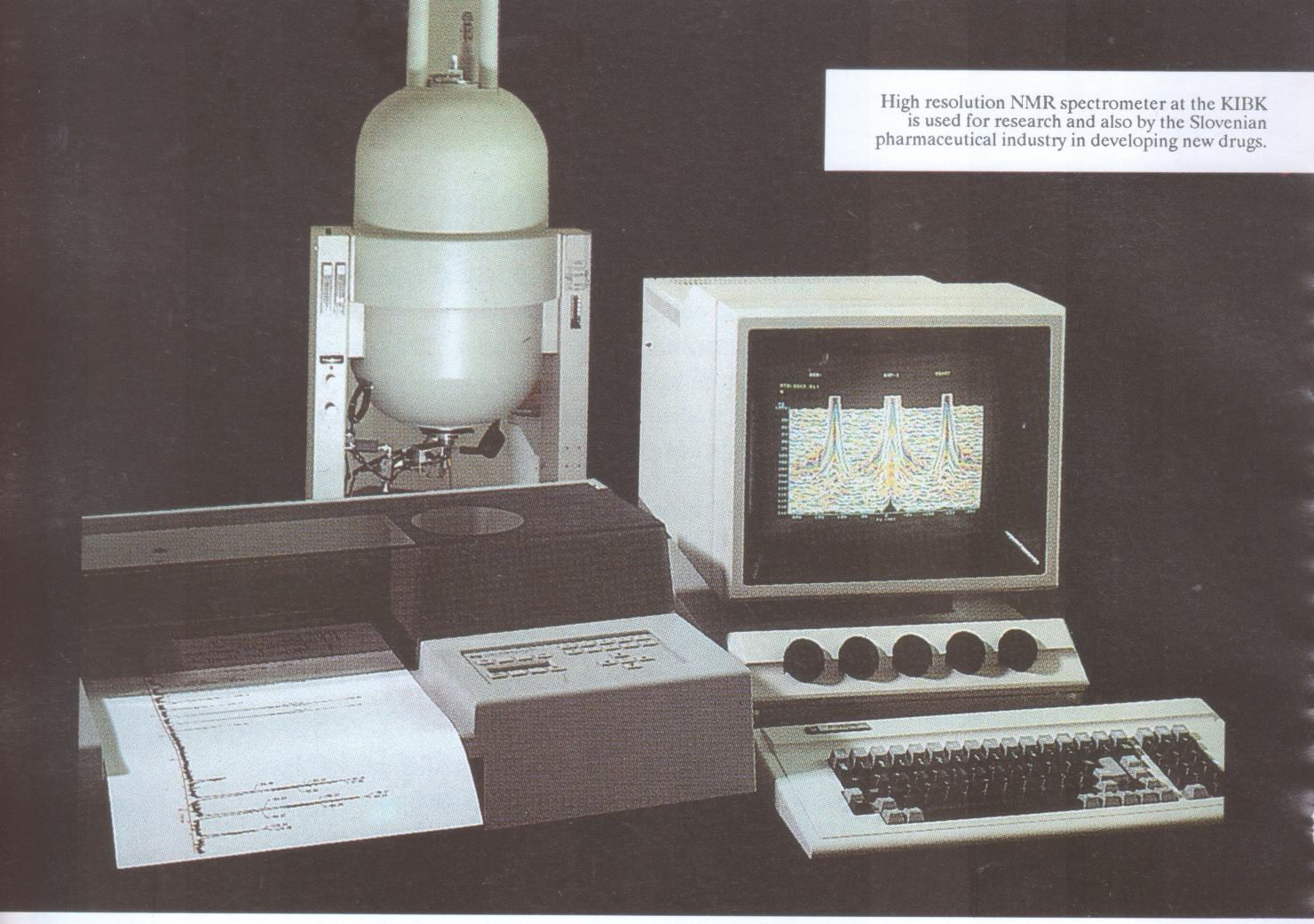
Head:
Academician
Dušan Hadži
Research Staff: 10

At the ***Boris Kidrič Institute*** research is being pursued in the field of ***Structural and Theoretical Chemistry***, where intermolecular interactions are studied by application of quantum chemical and statistical mechanics methods to the structure and dynamics of liquids. The structure and energetics of molecular complexes are investigated with relevance to biological structure and mechanisms. The group is also interested in protein folding and molecular recognition in pharmacology.

Head:
Prof. Dr. Rado Komel
Research Staff: 5

In the field of ***Molecular Biology and Genetic Engineering,*** the researchers deal with the molecular basis of biological evolution and interaction of DNA with regulatory proteins. The main project is focused on the cloning and expression of steroid bioconverting genes and the regulation of the steroid metabolism with recombinant DNA methodology. Further, the application of recombinant DNA technology in medicine is oriented towards the molecular mechanisms of diseases (cystic fibrosis, muscular dystrophy, haemophilia, etc.).

Infra-red ***Spectroscopy*** is applied to systems with strong hydrogen bonds, structure of phospholipids, electrooptical crystals and is used for studies of coatings for solar energy collectors. NMR Spectroscopy is used for conformational studies of pharmacologically interesting molecules, par-



High resolution NMR spectrometer at the KIBK is used for research and also by the Slovenian pharmaceutical industry in developing new drugs.

ticularly biological peptides. Within Chemometrics and Artificial Intelligence neuronal networks, graph theory and computer-based informational and expert systems are developed.

Head:
Prof. Dr. Tatjana Malavašič
Research Staff: 12

The group working in ***Polymer Chemistry and Technology*** is interested in the course, kinetics and mechanism of polymerization and the correlation between polymerization conditions and polymer structure. The subjects of their investigation are phenolic, urea and melamine resins, polyurethanes, epoxy resins, conducting polymers, reactive polymers and materials for the leather industry.

Head:
Prof. Dr. Milenko Roš
Research Staff: 9

The ***Chemistry, Biology and Waste Water Technology*** group is concerned with the development of analytical, physical, chemical and biological methods for pollution determination of surface water. Surface and waste water toxicity are studied, using physiological and ecological methods. Waste water treatment investigations comprise aerobic and anaerobic treatment, laboratory and pilot plant investigations, design and operation control of industrial and municipal treatment plants as well as new wastewater treatment technologies. Drinking, ground, industrial, surface and waste waters are being analysed.

The ***Catalysis and Chemical Reaction Engineering*** group deals with heterogeneous catalytic reaction engineering and synthesis and structural characterization of molecular sieves. The former topic comprises the study of catalytic activity and selectivity and reaction engineering. The latter activity is focused on synthesis of zeolites and aluminophosphates and physical-chemical characterization of active surface.

Head:
Prof. Dr. Janez Levec
Research Staff: 5

Silicate Materials research is oriented towards hydrothermal synthesis, to the surface properties of silicates characterization of silicate hydrates and as well as development of insulation materials and silicate binders with increased temperature stability. The other part of the group is interested in transport properties in thin ionic conductors and the development of impendance spectroscopy. In cooperation with the other research groups, investigation of Y-Ba-Cu-O oxide superconductors is being carried out.

Head:
Dr. Bogdana Kurbus
Research Staff: 10

The research in ***Organic Chemistry*** in Slovenia is an excellent example of the close link between basic and applied research. Institutions such as KIBK, IJS and University Faculties, such as the Dept. for Chemistry, the Biotechnical Faculty, various Institutes at the Medical School, and others, are joining the projects and staff with the two major pharmaceutical companies KRKA from Novo mesto and LEK from Ljubljana. These collaborations have already resulted in various patents and commercially successful products, particularly in the field of recombinant technology. Both companies also have their own R & D Laboratories and programmes, independent of the projects that they are financing at the research institutes and universities.

The most recent R&D projects at ***Krka***, Novo mesto, including synthesis, biopharmaceuticals, pharmacological, pre-clinical and clinical investigations, are listed below:

- chemotherapeutics of higher generations,
- chinolons - the therapeutics of higher generation,
- beta-lactam antibiotics of higher generation,
- antiviral compounds,
- inhibitors of angiotensin converting enzymes,
- Ca - antagonists, dihydropyridine derivatives,
- proteolytic enzymes and their inhibitors, produced by molecular biology technology - new types of these compounds were patented recently and the preclinical investigations are in progress.

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Lek Ljubljana
Director of R&D:
Dr. Miha Kremser
Research Staff: 83
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Fax: 38-61 553-350

The research and development group at ***Lek***, Ljubljana, numbers about 200 researchers involved in the development of new drugs with preclinical experiments, clinical studies, pharmacokinetics and pharmaceutical technology.

- organic synthesis: heterocyclic compounds: structure and function,
- project peptides: synthesis and genetic engineering,
- genetics and microbiology for biotechnology products,
- analytical methods: mass spectrometry and chromatography.

Faculty of Natural Sciences and Technology
Organic Chemistry Department
Head:
Prof. Dr. Miha Tišler
Address: Murnikova 6
Tel.:38-61 214-444

At the ***University of Ljubljana***, Department of Chemistry, the research activities are organized in the project *"Syntheses and Reactivity of New Organic Compounds"*, divided into the following sub-projects:

- 1,3-Dipolar cycloadditions of diazoalkanes to heteroaromatic monocyclic and polycyclic systems,
- Syntheses of nonproteinogenic amino acids and their use as syntons for heterocyclic compounds,
- Syntheses and transformations of amidoximes, oxazolidinones and condensed pyrones,
- Structure and reactivity of organic peroxy compounds,
- Photochemistry of bioactive compounds.

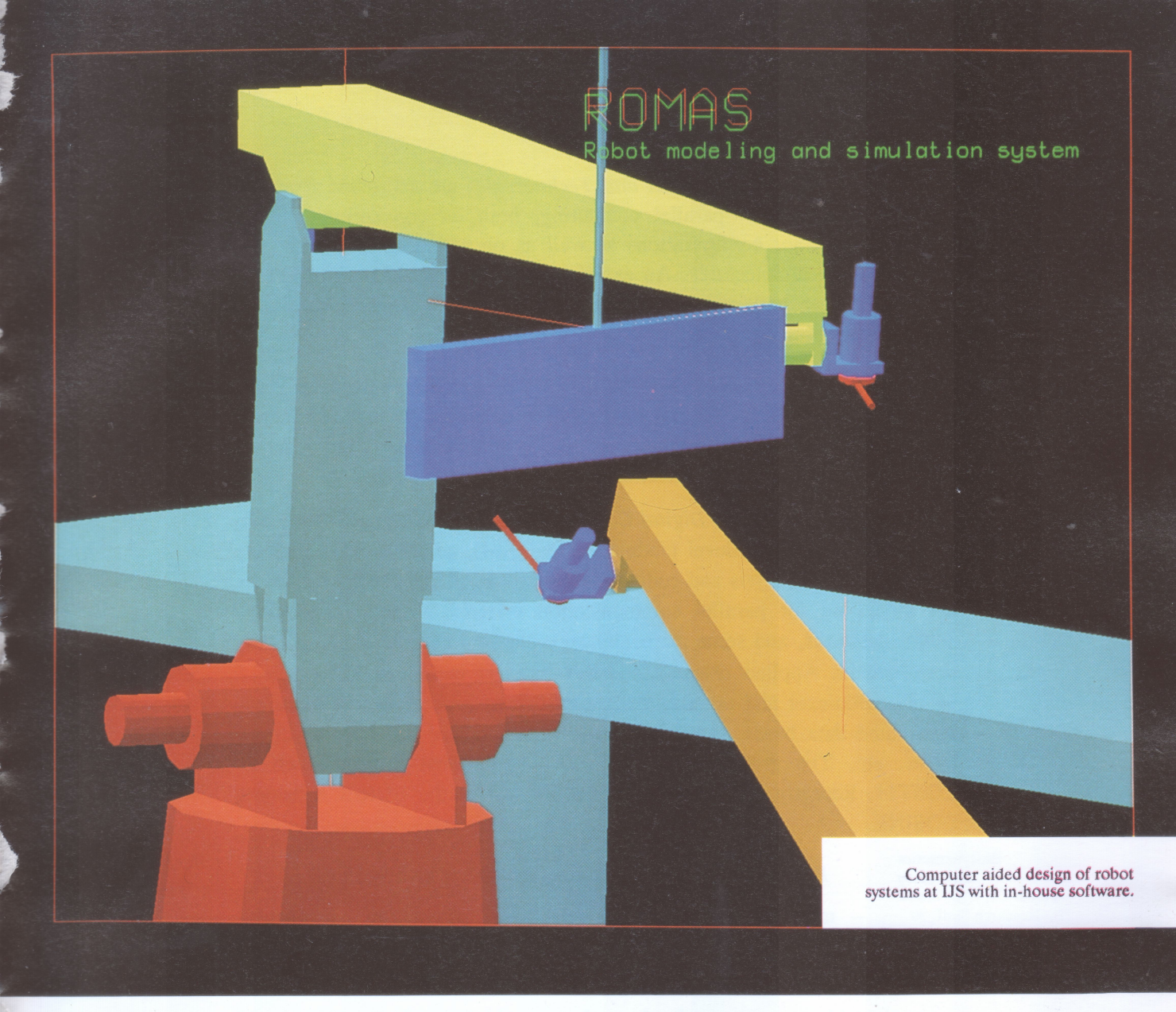
METALLURGY

Institute for Metallurgy
Director: Dr. J. Rodič
Research Staff: 92
Address: Lepi pot 11
61 000 Ljubljana
Tel: 38-61-332-502

The research in ***Metallurgy*** is organized in 4 major programmes comprising 87 projects:

- New Materials, Components, and Technologies for Electronics,
- Energy and Raw Materials Economics in Metal Industry,
- Processes and Reactions in Liquid Metals and Slags,
- Physical Porocesses in Solid Metal Materials.

Computer methods in metallurgy are widely applied and the Institute is a major educational centre in its field of activity. International cooperation with similar institutions in eight European countries, India and USA represents a significant part of the research.



Computer aided design of robot systems at IJS with in-house software.

COMPUTER SCIENCE, INFORMATICS, AUTOMATION AND CONTROL

Department of Computer Science and Informatics
Artificial Intelligence Laboratory
Head:
Prof. Dr. Ivan Bratko
Research Staff: 17

At the Jožef Stefan Institute the ***Artificial Intelligence*** research is focused on:

- machine learning and automatic knowledge generation,
- qualitative modelling,
- heuristic and logic programming,
- languages and tools for artificial intelligence,
- expert and decision support systems.

Research has resulted in several prototypes and commercial applications such as expert system shells ASSISTANT, GINESYS, LINGUS and PROSPECT. Among others a highly successful monography, distributed world-wide, "Prolog Programming for Artifical Intelligence" by Prof. Dr. Ivan Bratko has been published.

Head:
Dr. Marjan Špegel
Research Staff: 44

Computer Systems and Technologies are addressed from the viewpoint of parallel computing, both on conventional multiprocessor configurations as well as on advanced data flow and data reduction architectures. An experimental Q-bus-based multiprocessor system has been built and a multitasking scheduler for IBM PC's running MS-DOS has been developed.

Research on ***Computer-aided Design*** includes languages for description of geometric configurations and manipulations, and applications in general-purpose programming environment for NC, system diagnostic, initialization of parallel systems and identification of faculty units and similar.

Head:
Dr. Janez Korenini
Research Staff: 21

Research on ***Digital Communication and Computer Networks*** includes multilevel modulation (MQAM), adaptive digital filters, signal analysis and coding, error estimation and modelling, channel modelling for parallel communication systems, systolic arrays and neural networks, and some mathematical modelling and cluster algorithms development. Applied research and development include a TDM 2/8/34 MHZ multiplexer and other applications such as process synchronisation, distributed data bases, electronic mail with computer and service directories, etc. The group cooperates with international projects such as COST11. Recently the group became a member of the EURECA project COSINE.

Biocybernetics
Laboratoy
Head: Dr. Uroš Stanič
Research Staff: 30

Biocybernetics at Jožef Stefan Institute is involved in:

- multichannel functional electrical stimulation, evaluating effects of multichannel stimulation and improving methods for initialisation and correction of patients gaits;
- implantable systems of electrodes, problems of corrosion and improvement of the synchronisation between transmitting and receiving antennas;
- measurements of the biomechanical and kinematic parameters for description of walking with endoprosthesis, and for research into neurocontrol and arm movement.

Among others, a data processing system HIPOKRAT has been developed as well as a number of various stimulators.

Laboratory for
Biocybernetics
Head:
Prof. Dr. Lojze
Vodovnik
Address: Tržaška 25
61000 Ljubljana
Tel.: 38-61 265-161
Fax: 38-61 264-990

The Laboratory of ***Biocybernetics*** at the Faculty of Electrical Engineering and Computer Science of the University of Ljubljana is covering two major research areas:

In the first phase - from the mid sixties to the end of the seventies - the possibilities of electric currents for the restoration of impaired movements due to different types of neuromuscular diseases were studied.

The Slovenes are enchanted by the bees. Bee products are extensively used in pharmaceutical and cosmetic products.

In the second phase - initiated at the beginning of the eighties - research into the therapeutic effects of electrical currents has been conducted. The ongoing activities cover four major research areas of therapeutic electrical stimulation:

- modification of neuromuscular impairments in patients with motor disfunctions - such as spasticity and rigidity; muscle plasticity - modification of properties of normal or dystrophic muscles,
- peripheral nerve regeneration,
- wound healing,
- cancer treatment.

These activities require: development of technology (electrical stimulators, measuring devices), data and signal processing and non-linear system modelling. In addition, much clinical and experimental work is involved in collaboration with medical institutions.

Robotics at the Jožef Stefan Institute does research on the kinematics of human limbs and robots, path planning and robot control, as well as on the industrial application of robots. The problem of hyperredundant robot and its inverse kinematics was

Laboratory for Robotics
Head:
Prof. Dr.
Jadran Lenarčič
Research Staff: 30

solved; mathematical modelling of human arm to describe its movement and workspace was studied using the Ljapunov functions. This research resulted in the development of several types of prototypes and in the introduction of industrial robots in cooperation with industry (RIKO 106, STEFAN 130, RIKO, CIMOS, STEINEL) and universities abroad (Graz).

Laboratory for Robotics
Head:
Prof. Dr. Alojz Kralj

The research work in the laboratory of ***Robotics*** at the Faculty of Electrical Engineering and Computer Science is divided into practical and theoretical developments. The practical developments are directed towards introducing robot manipulators into industrial processes where the assembly of small parts is necessary. The efficient assembly robotic cell of hybrid circuits has been developed for a national producer of electronic components and devices. The problems of robot calibration are also being closely studied. Current development is directed towards the robot cell for assembly of SMT electronic circuits. These research activities are directly supported by our industry, while the latter project is also co-funded by the UNIDO programme.

Head:
Prof. Dr. Stanko Strmčnik
Research Staff: 20

Research in ***Automation and Process Control*** at IJS is dealing with the principles, procedures and methods of system theory with particular interest in control system identification, optimization and adaptive control. To support advanced control methods various tools are being developed including software for control engineering (CACE), system design (CACSD) and software engineering (CASE). The resulting application support involves:

- design of task dedicated modules for unconventional control problems,
- design and construction of complete control equipment systems for batch and continuous chemical and other process industries.

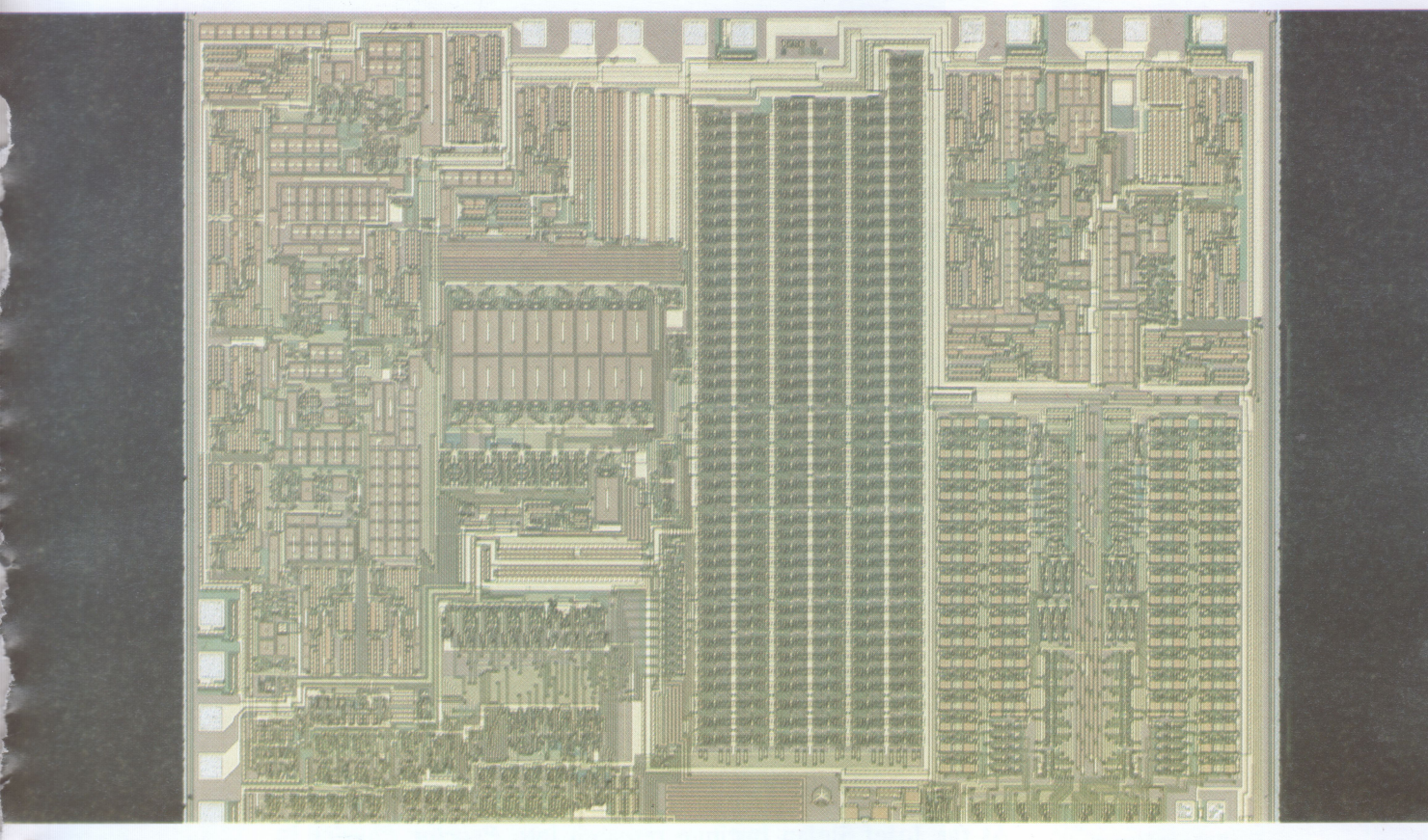
Such system's were successfully implemented in paper pulp production, titanium dioxide production, in steam boiler control etc. The implementation is carried out in close cooperation with the daughter company INEA established for that purpose. A part of the research in this area is performed jointly with the Technische Hochschule in Darmstadt, Germany and others.

Head:
MSc Radovan Tavzes
Research Staff: 29

Energy and Process Control research at IJS is specifically oriented towards system control intended for and adapted to problems of energy conservation and energy process control. Particularly, problems of complex industrial systems including cogeneration and energy intensive processes, and demand-supply optimization on large scale level are investigated.

The resulting application of research includes feasibility studies, consulting and energy auditing, as well as participation in national projects on industrial energy conservation and in international cooperation within UNIDO and EC on industrial energy-use efficiency.

Advanced integrated circuit for telephones designed in the Laboratory for Microelectronics of the Faculty of Electrical Engineering and Computer Science, University of Ljubljana.



ELECTRONICS

Laboratory for Microelectronics
Head:
Prof. Dr. Lojze Trontelj
Research Staff: 31

Due to the long tradition in the manufacture of electronic components and systems in Slovenia, there is great interest in research in different fields of electronics. Most of this research at the fundamental level is performed at the Faculty of Electrical Engineering and Computer Science of the University of Ljubljana. The research in ***Microelectronics*** comprises four groups: one is working on modern CMOS integrated circuit process technologies; one on integrated circuit design; one on design and analysis of complex electronics systems and one on developing new CAD tools and methods. The efforts of the Laboratory are directed towards the submicrometer CD region both in the design and in the technologies. The design orientated groups specialize on mixed analog- digital circuits, combined on the same chip.

Some of the most successful projects carried out in the Laboratory include several telephone chips (now in production); a library of analog cells, which are used in the design of mixed integrated circuits; CAD tools for automatic analog and SC filter design, for automatic synthesis and layout compilation of operational amplifiers, and a custom designed process for IC production.

Recently the Laboratory has built a new process laboratory with relatively up-to-date equipment and is presently in the process of starting up the facility.

The Laboratory of Microelectronics has traditionally been a centre of learning in its field, closely collaborating with electronic companies in Yugoslavia and abroad. A number of its members are research fellows working in the Laboratory with the purpose of learning new design and process skills on modern equipment.

The research activities in ***Electron Devices*** are divided into two groups. In the field of crystaline silicon research:

- modelling of Si material and device properties,
- analytical and computer stimulation of internal and external properties of Si devices and solar cells.

Laboratory for Nonlinear Elements
Head:
Prof. Dr. Jože Furlan

Fundamental research in the field of ***Non-linear Elements*** is dedicated to the modeling of physical-material and electrical characteristics of silicium semiconductor structures. Also studied are the problems of bipolar semiconductor components.

NUCLEAR ENGINEERING

Reactor Physics
Head:
Dr. Bogdan Glumac
Research Staff: 25

At the Jožef Stefan Institute research into ***Reactor Physics*** is undertaken; and modelling of reactor core and fuel calculations applied for enhancement of economics and safety of research and power reactors are also being investigated. Related to safety is research on reactor pressure vessel embrittlement surveillance, including (fast) neutron dosimetry, nuclear track detectors, X-ray, microfocus and neutron radiography, mechanical testing of samples and other nondestructive methods.

Applied research to support operation of the NPP Krško has shown encouraging results. A novel reactivity meter has been developed and advantageously used in nuclear power plants.

Reactor Engineering
Head:
Prof. Dr. Borut Mavko
Research Staff: 20

In ***Reactor Engineering*** research is being done on basic thermohydraulics, and on structural, melting and solidification problems. In addition man-machine interaction and industrial hazards studies are being done, with particular emphasis on nuclear safety. A number of programmes for transient analysis, thermohydraulic, phenomena calculations, structural analysis, simulation of plants or components are also being used and developed jointly with other laboratories (such as INEL, USA). Research is also being done on boundary elements methods to complement simulation and understanding of phenomena.

Of particular significance is the cooperation in the interpretation of experiments on facilities for reactor accident simulations such as SPES (Italy), Achilles (UK), ISP-25 Bethsy (F) and similar, and on the probabilistic safety analysis to be inplemented on the TRIGA research reactor and NPP Krško. In addition, applied research and professional expertise is used by the Nuclear Safety Administration of Slovenia.

MECHANICAL ENGINEERING

In ***Civil Engineering*** several very active groups are working on:

Department of Civil Engineering of the Ljubljana University
Tel.: 38-61 268-741

- earthquake engineering and structural dynamics,
- mathematical modelling of 1 and 2 dimensional (2D) free-surface flows (flood waves, dam-break waves, detailed 2D flow around hydraulic structures),
- three-dimensional hydrodynamic models of circulation and dispersion of pollutants in rivers, lakes and coastal seas,
- water quality modelling, environmental engineering, limnology, waste-water recycling etc.,
- hydrologic models,
- computer analysis of structures is also widely applied.

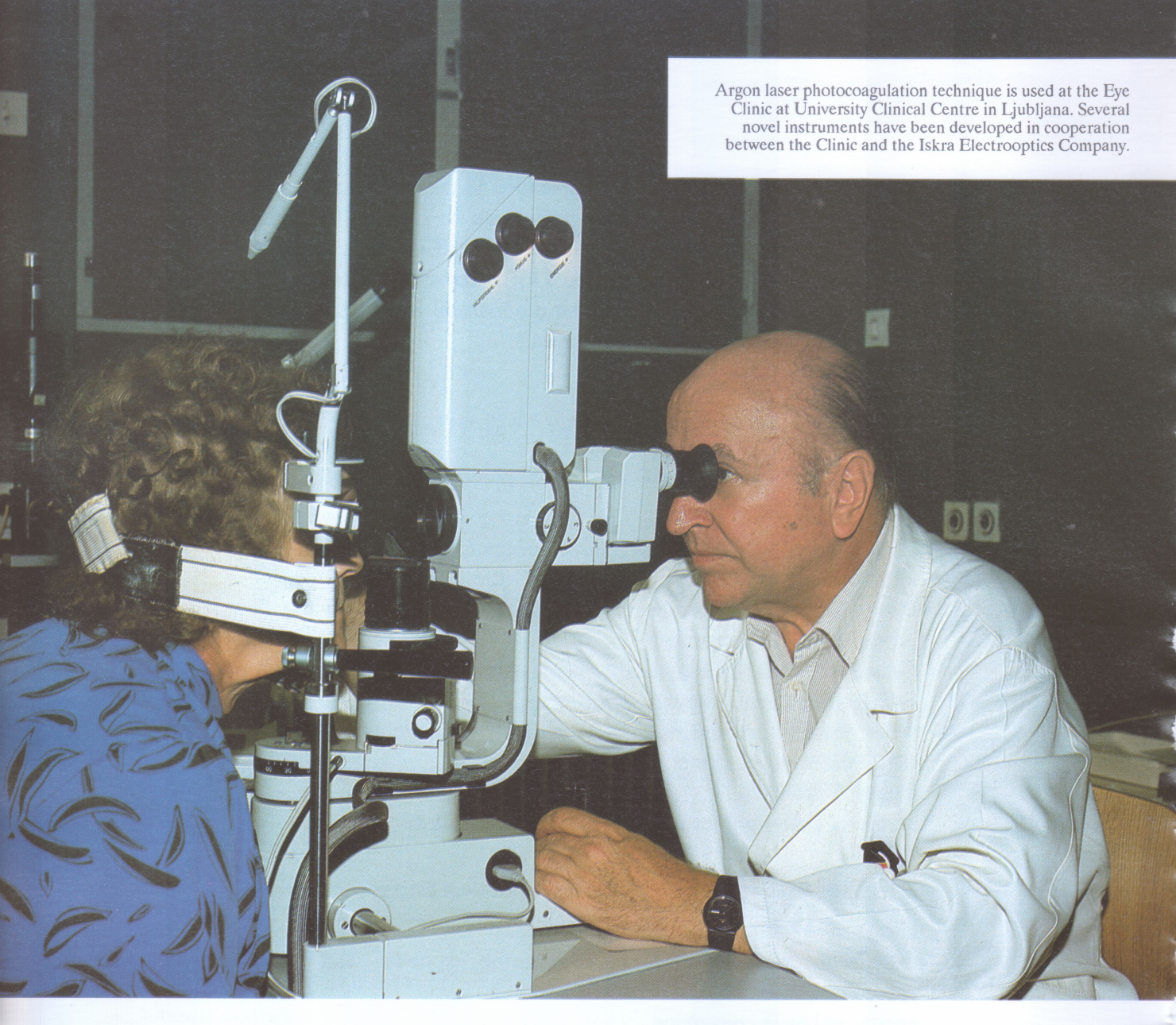
The fundamental research projects in ***Mechanical Engineering*** are:

Faculty of Mechanical Engineering of the Ljubljana University
Tel.: 38-61 223-133
Fax: 38-61 218-567

- design of engines and machines,
- manufacturing cybernetics, manufacturing systems and robotics,
- energy and mass conversion,
- systems analysis in energy & power engineering,
- heating, cooling and air-conditioning,
- new technologies in energy conversion and use, energy production and consumption in industry,
- welding,
- traffic systems.

Particular topics studied are:

- linear and nonlinear viscoelasticity,
- rheology,
- fatigue and fracture of polymers and composites
- experimental techniques for material characterization
- experimental and theoretical studies on coherent structure interactions.



Argon laser photocoagulation technique is used at the Eye Clinic at University Clinical Centre in Ljubljana. Several novel instruments have been developed in cooperation between the Clinic and the Iskra Electrooptics Company.

MEDICINE

University Clinical Center of Ljubljana and Faculty of Medicine

Director:
Prof. Dr. Primož Rode
Address:
Zaloška 3
61000 Ljubljana
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Fax: 38 61 315-583

The various activities in the clinics and in various fields of medical research are carried out at the modern University Clinical Center of Ljubljana. Supported by the most sophisticated instruments for diagnosis and therapy, the work with patients goes hand in hand with research and teaching. The Clinical Center comprises 20 University Clinics of all medical branches - from Surgery, Gynaecology, Pediatrics, Clinical Chemistry and Biochemistry, Stomatology, etc. and 11 Institutes of the Medical School. In addition, there are various forms of collaboration with universities and institutes, such as with the Jožef Stefan Institute, the Biotechnical Faculty and Biotechnology Cen-

ter, the Transfusion Unit, etc. The high quality of the hospital, which also attracts numerous patients from abroad, is a reflection of excellent research work, particularly in the following fields:

- Neurobiology,
- Human reproduction,
- Heart and coronary diseases,
- Oncology,
- Ageing,
- Immunology, Microbiology and Virology,
- Mental health,
- Stomatology.

Of these, the most prominent groups are working in the following branches:

Pathophysiology

Modern equipment for electron microscopy, cytochemistry, molecular biology, analytical and protein biochemistry, electrophysiology, etc. enables various research activities to be carried out in 11 different laboratories. The main topics are centered on:

- the fundamental properties and regulatory mechanisms of components of the cholinergic system in health and disease, leading to understanding of the communication among nerve cells and how various signals are transferred through the body and into the central nerve system.

Institute for Pathophysiology
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Dir. of Research:
Academician
Miro Brzin
Research Staff: 17
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The main topics in ***Medical Biochemistry*** are:

- biochemistry and molecular biology of cytochrome P-450 from the filamentous fungus *Rhizopus nigricans* with the final aim of understanding the regulation of the induction process by steroids in primitive eucaryotes.
- the specific receptors for progesterone, one of the most efficient inducers. The question to be answered here is whether the induction mechanism follows the pattern typical with steroids for induction in higher organisms or whether the induction is influenced more by the function of the gene which is turned on by the inducting compound.

Institute for Biochemistry
Head:
Prof. Dr. Katja Breskvar
Research Staff: 4
Address: Vrazov trg 2
Ljubljana
Tel.: 38-61 120-016
Fax: 38-61 311-540

The major current topics in ***Clinical Neurophysiology*** :

- localization of lesions in the visual pathways with visually evoked responses; vision and other senses after mechanical stimulation,
- effects of drugs on memory and other brain functions,
- Parkinson's disease, brain tumors, activities in brain-dead patients, and many other diseases.

Institute for Clinical Neurophysiology
Head:
Dr. David B. Vodušek
Research Staff: 10
Address: Zaloška 7
Ljubljana
Tel.: 38-61 316-152
Fax: 38 61 302-771

Institute of Gerontology
Head:
Prof. Dr. Dušan Keber
Research Staff: 5
Address: Riharjeva 5, Ljubljana
Tel.: 38-61 218-453
Fax: 38-61 223-042

The research in ***Gerontology*** is very clinically oriented, with investigations into:

- thrombosis and arteriosclerosis, directly linked to clinical practice. In particular, the mechanism of the involvement of a proteolytic enzyme, t-Plasminogen activator, in fibrinolysis in various coronary diseases,
- an *in vitro* model for the dissolution of blood thrombi under various conditions has been developed. The results are directly applicable in the therapy: recently, a new treatment of arterial thrombosis, in which the fibrinolytic agent is directly introduced into the thrombus, has had great success.

Institute for Oncology
Director:
Dr. Matjaž Zwitter
Research Staff:
Address: Zaloška 2, Ljubljana
Tel.: 38-61 316-490
Fax: 38-61 329-177

The very nature of ***Oncology***, due to numerous unexplained and unsolved problems, calls for permanent research in scientific confirmation of research results in the experimental laboratory as well as in clinical practice. Two large programmes are being carried out at the Institute for Oncology, both including various smaller individual projects:

- Oncology and Cancer Diagnosis,
- Treatment and Prevention of Disease-and-Treatment-Related Complications.

The research within oncology can be grouped into several main topics:

- carcinogenesis,
- growth and characteristics of tumors,
- host-tumor relationship,
- detection and diagnosis of cancer,
- cancer treatment,
- prevention.

In this field, the individual and institutional links with world agencies are especially important: for example with IUCC (International Union Against Cancer), OECI (Organization of European Cancer Institutes), NCI (National Cancer Institute, USA), EORTC (European Organization for Research and Treatment of Cancer) and some of the IARC (International Agency for Research on Cancer) , to mention only the most important in addition to at least 20 other international organizations.

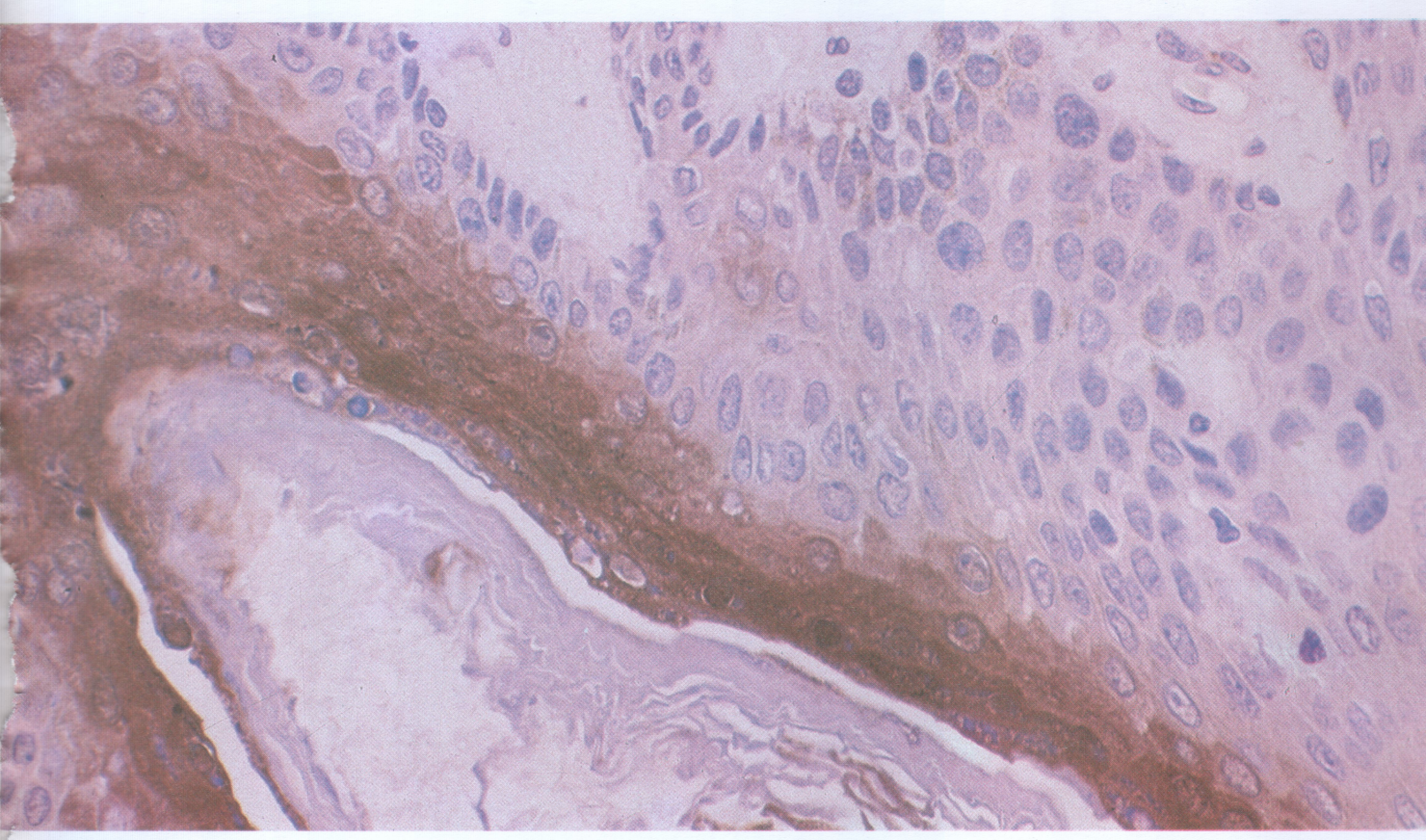
Department of Obstretics and Gynaecology
Director:
Prof. Dr. Božo Kralj
Head of Research:
Dr. Marjan Pajntar
Research Staff: 30
Address: Šlajmerjeva 3 Ljubljana
Tel.: 38-61 312-714
Fax: 38-61 101-110

The main topics ***Obstetrics and Gynaecology***:

- preterm labour, preterm infants and their subsequent development,
- human reproduction (6 themes).

In collaboration with WHO, the special programme of research, development and research training in human reproduction is carried out through the major longitudinal study on acute pelvic inflammatory disease and infertility.

In search for new tumor antigens: collaborative investigation including immunohistochemical methods are carried out between the IJS and the Institute for Oncology.



In the field of ***Clinical Cardiac Electrophysiology*** the main topics of research and clinical investigation are conducted on:

- tachycardia-induced cardiomyopathy,
- epicardial mapping in arrhythmia surgery,
- conduction disturbances in neuromuscular diseases,
- haemodynamics with arterial and ventricular pacing.

In particular, the following projects are being investigated:

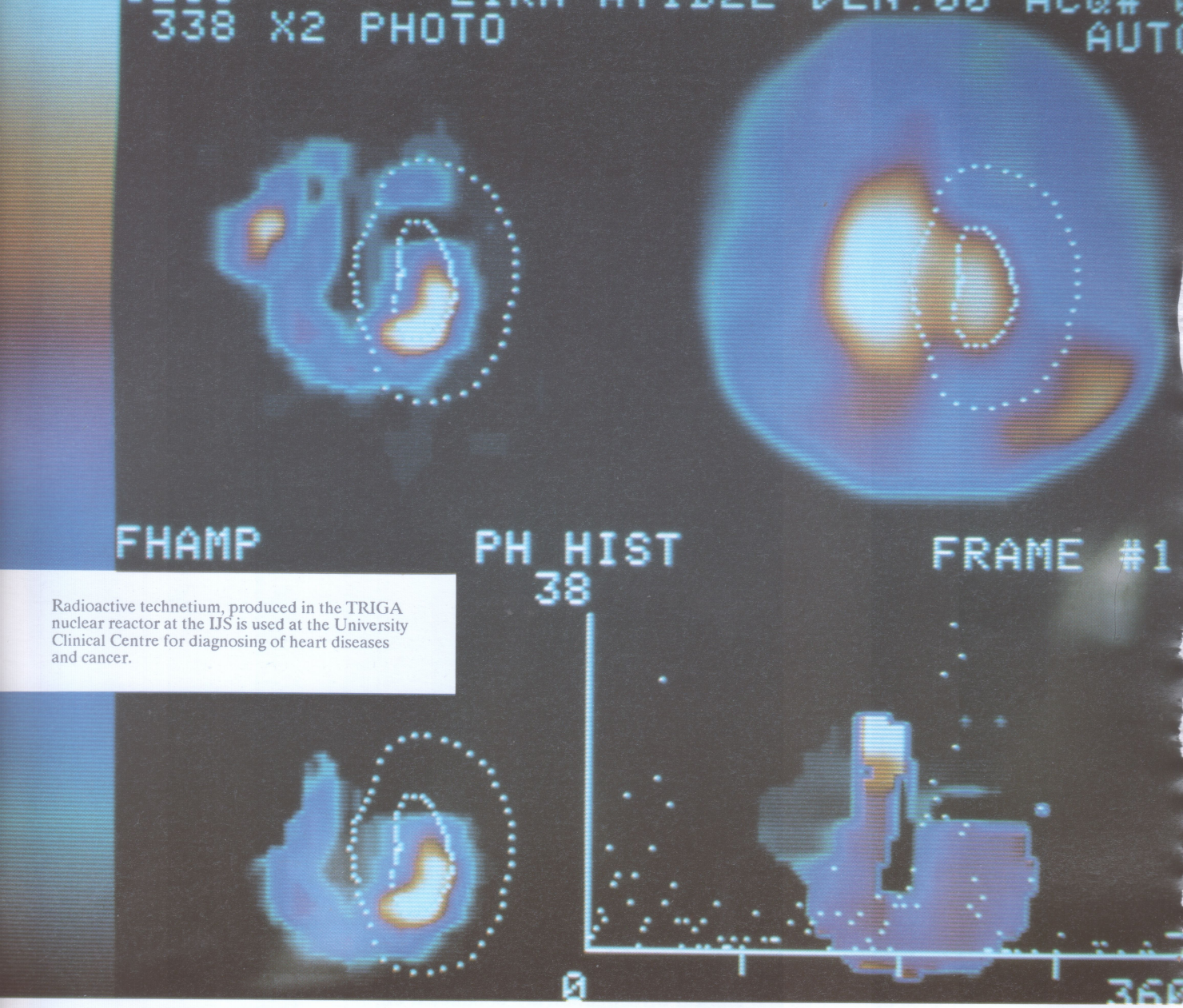
- Late Ventricular Potentials in Cardiac Arrhythmias
- Postextrasystolic Potentiation in Heart Failure
- The Study of Neurohumoral Activity in Patients with Heart Failure
- The Von Willebrand Factor in Acute Myocardial Infraction

Department for Internal Medicine - Cardiology
Head:
Prof. Dr. Matija Horvat and Prof. Dr. Peter Rakovec
Research Staff: 24
Address: Zaloška 7
Ljubljana
Tel.: 38-61 317-057
Fax: 38-61 302-455

The ***Stomatology*** research is interdisciplinary, carried out by physicists, chemists and dentists. Major projects include the research on:

- epidemiology, etiopathogenesis and prevention of periodontal disease,
- dental caries,

University Dental Clinic
Director:
Prof.Dr. Mitja Bartenijev
Research Staff:
Address: Hrvatski trg 6
Ljubljana
Tel: 38 61 113-113



Radioactive technetium, produced in the TRIGA nuclear reactor at the IJS is used at the University Clinical Centre for diagnosing of heart diseases and cancer.

- NMR spectroscopy and tomography in stomatology,
- radiation defects in hard material and tissues,
- laser effects on dental and periodontal tissues.

Recently, the research in this field has grown considerably and the multi-disciplinary research ***Centre for Dental Research*** had been established at the Jožef Stefan Institute, where the basic and applicative research programmes and postgraduate courses in stomatology have recently started.

Center for Dental Research IJS
Head:
Prof. Dr. Uroš Skalerič
Tel. 38-61 159-199
Fax: 38 61 161-029

AGRICULTURE AND BIOTECHNOLOGY

Although agriculture is the oldest occupation in Slovenia, it has now become a high-tech activity, aiming to achieve top quality products in sufficient amounts. Parallel with the establishment of biotechnology as one of the priority development projects in 1987, the ***Biotechnical Faculty*** established the ***Biotechnology Centre,*** with the aim of coordinating research in biotechnology and agriculture. It also serves as a link between educational and research activities inside and outside the faculty and it provides contacts with the industry. The main topics in the field are carried out by the following institutions and groups:

Agronomy Department
Director:
Prof. Dr. Franc Lobnik
Research Staff: 49
Address:
Jamnikarjeva 101
Ljubljana
Tel 38 61 264-761,
Fax: 38 61 261073

Very active and internationally supported research in ***Agriculture*** is going on in several fields related to specific problems in Slovene agriculture. The main topics are: improvement of technology of field crops, plant protection, investigations to improvement agronomic relevant properties of horticultural plants, forage plants in mountain regions.

Additionally emphasis is devoted to agroeconomical sciences, extension education, rural sociology and agricultural informatics.

The Laboratory for ***Soils, Plant Nutrition and Environment***, of which the main topic is the soil mapping and analysis, is collecting the information basis for the geographic information systems and pollution studies.

The Laboratory for ***Plant Genetics*** develops both classical genetic and ***Molecular Biology*** methods for genetic research, which is oriented towards plant breeding of crops such as buckwheat, chicory, cabbage and apples.

Agriculture Institute of Slovenia
Director: Slavko Gliha
Research Staff: 14
Address:
Hacquetova 2,
Ljubljana
Tel 38-61 123-111
Fax 38-61 323-057

The Slovene Institute for Agriculture comprises various laboratories, such as the Laboratories for ***Cell and Tissue Culture, Nematology and Enology***, the ***Agrochemical Laboratory***, the Laboratory for ***Measurements***, etc. It also includes stalls and several square miles of land. Practical and theoretical considerations include:

- cultivators for potatoes,
- clone selection of vineyards,
- new methods for determination and extraction of nematodes,
- NMR analysis, pesticide research with CG-MSD methods,
- alternative drying methods and aerodynamics of plant-drying,
- degradability of organic matter and proteins in animal food,
- genetic and morphologic changes in the Carniolian honey-bee,
- microeconomics of agricultural units.

The Institute for Hop Research and Brewing
Head: Milovan Zidar
Research Staff: 6
Address:
Žalskega Tabora 2
63310 Žalec
Tel: 38-63-711-221
Fax: 38 63 712-163

The Institute for ***Hop Research and Brewing*** was established in the mid-sixties as a research institution for the common problems in hop growing. Now the Institute has two major goals: improving hop aroma and fighting plant viruses.

Zootechnical Department
Director:
Prof. Dr. Franc Habe
Research Staff: 22
Address: Groblje 3,
61230 Domžale
Tel: 38-61 711-986,
711-982, 711-984, 713-611
Fax 38-61 721-005

In ***Animal Husbandry***, the major topics are in the field of zootechnics, related to specific problems in Slovene agriculture such as:

- information systems in animal husbandry sciences,
- animal ethology,
- immunogenetics and hybridoma technology,
- animal transgenecity,
- aquaculture biotechnology,
- anaerobic microbiology,
- intestinal microecology.

and various applicative projects, such as selection and animal feeding, milk production, etc. The Laboratory for ***Animal Biotechnology*** at this department is investigating:

- immunology,
- sex-gene manipulation in rainbow trout,
- DNA diagnostics and genome analysis,
- in vitro expression,
- manipulation of genes.

Department of Food Technology
Director:
Prof. Dr. Janez Hribar
Research Staff: 20
Address:
Jamnikarjeva 101
Ljubljana
Tel: 38-61-261-761
Fax: 38 61 266-296

Food Technologies R&D take place in several Laboratories including:

- Meat technology,
- Processing of fruit and vegetables,
- Enology and yeast technology,
- Microbial ecology,
- Food microbiology,
- Biotechnology.

Forestry Department
Director:
Prof. Dr. Franc
Gašperšič
Research Staff: 24
Address: Večna pot 83,
Ljubljana
Tel 38-61-268-963
Fax: 38 61 261-169

Engaged with the common problems of ***Forestry***, the research is focused especially on forest decline and tree response to mechanical and pollution injuries. There is a close link with the Institute for Forestry and Wood Economy, testing wood quality and especially the anatomy of wood and bark. A very original approach to forest biotechnology on a biophysical basis has recently been started, trying to find ways of influencing gene expression

Viticulture has a long tradition in Slovenia, and is now a prominent research subject at various agricultural institutions.

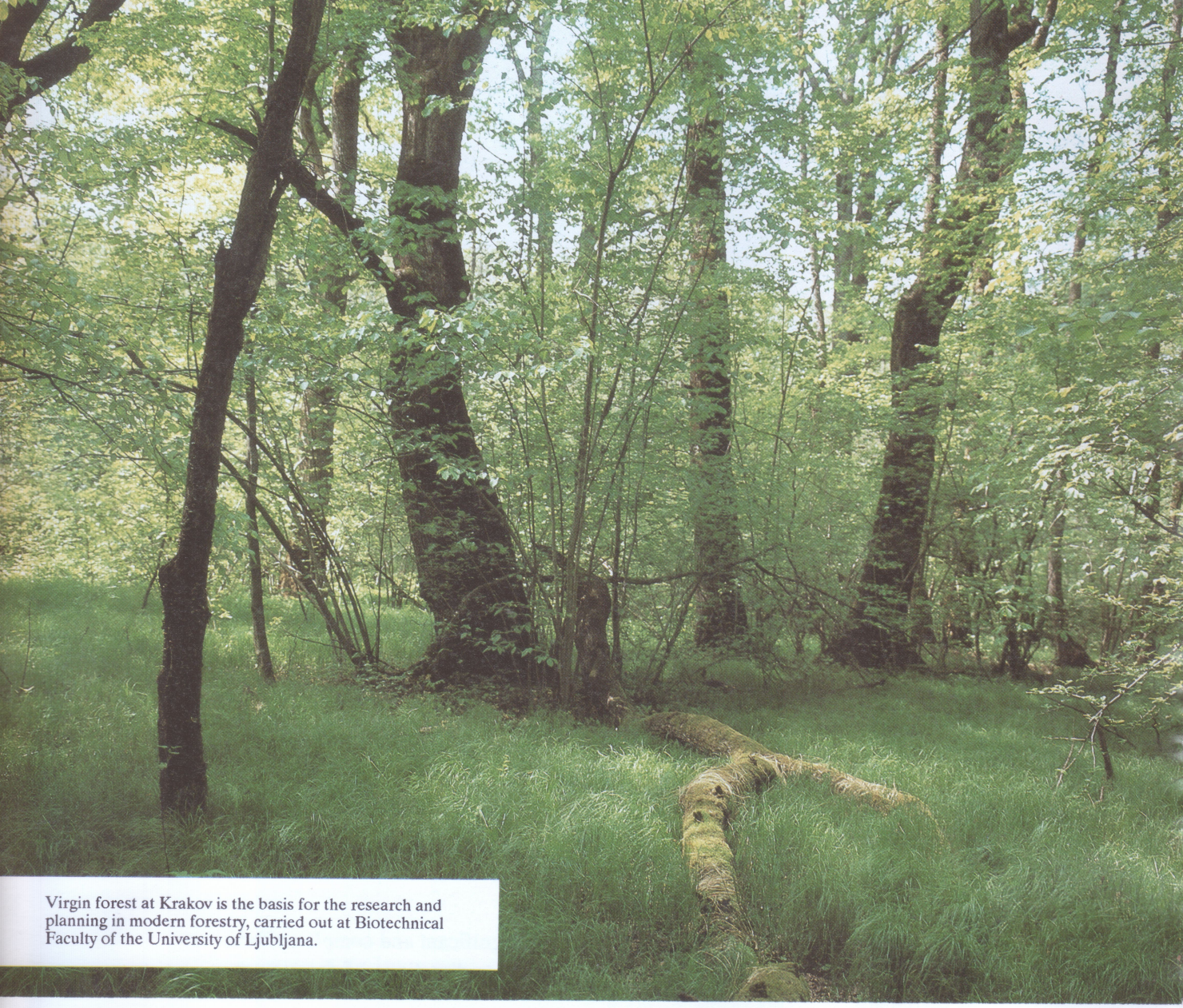
by means of the electromagnetic field, where significant and complex effects on regeneration were found. Some of the major directions of forestry research are:

- the holistic concept of natural productive forests,
- the multiple use forestry - effective use of forest resources in the preservation of the environment, leading to the elimination of conflicts between nature preservation and economy,
- the research on virgin forests as a basis for forest management in future,
- development and technology transfer in forestry,
- planning the wood as a natural ecological system: the wood as a process vs. the wood as a product.

The group, headed by Prof. Dr. Dušan Mlinšek established the International Association PRO SLIVA (1989).

The Institute is the only non-university forestry research organization in Slovenia. It is interdisciplinary oriented, with the major impacts on Forest Ecology, Forest Monitoring and Interpretation, Forest and Forestry Information Retreival and Forest Decline.

Institute for Forest and Wood Econony.
Director: Marko Kmecl
Research Staff: 29
Address: Večna pot 2
61000 Ljubljana
Tel: 38-61-268-963



Virgin forest at Krakov is the basis for the research and planning in modern forestry, carried out at Biotechnical Faculty of the University of Ljubljana.

The widespread international collaborations, include the studies of :

- stress physiology and the forest decline monitoring system in Slovenia with especially methodological approach in Slovenia - Austrian Area (COST programme and others in the Alpe-Adria regions),
- biomass as important source of energy (Udine, Italy),
- large scale micropropagation of woody plants (The British Council),
- development and decision support computer system for the estimation of wood transportation costs from a cutting place to a mill (IUFRO - Int. Union of Forestry Research Organization).

Wood Science and Technology deals with:

Department of Wood Science and Technology
Director:
Prof. Dr. Franc Bizjak
Research Staff: 24
Address: Ljubljana
Rožna dolina, c. VII/34;
Tel 38-61 272-261
Fax: 38 61 272-297

- biological, physical, mechanical and technological properties of wood, in particular tropical wood, with promotional studies on lesser-known tropical woods. The integrated utilization of tropical forests is studied. In this respect, various international links, particularly with USA and Mexico, have been developed,
- wood-based materials, such as particle boards, fibre boards, structural and composite boards are studied in addition to the application and curing of glues and testing of glued woods,
- chemical wood-processing is a broad field involving several projects, where the activities are linked to those of several German and American research teams.

There is also close collaboration with ***Pulp and Paper Institute*** of Ljubljana. Investigations are carried out on:

Pulp and Paper Institute of Ljubljana
Director: Janez Hočevar
Research Staff: 5
Address: Bogišičeva 8, Ljubljana
Tel.: 38-61 159-200
Fax: 38-61 217-797

- mechanisms of the application of filters, pigments, auxiliary additives,
- technology of paper finishing, etc.,
- chemistry and application of wood derivatives, fibre chemistry,
- technology of sulphate and sulphate pulp, bleaching processes,
- processing technology, etc.

In ***Veterinary Science*** various research groups are working in the fields of morpholgy, endocrinology and cell biology, the largest projects being:

Veterinary Faculty
Director:
Prof. Dr. Milan Pogačnik
Address: Gerbičeva 60
Ljubljana
Tel.: 38 61 158-292
Fax: 38 61 218-005

- Cell Biology and Molecular Genetics as Applied to Reproduction, Growth and Development of Domestic Animal Species,
- Cellular Mechanisms Regulating Reproduction, Growth and Development,
- Receptors of Pituitary Gland,
- Food Hygiene,
- Research and Elimination of Enzootic Bovine Leucosis,
- Degenerative Bone Diseases in Pigs and Pig Stress Syndrome (PSS,)
- Blood Groups and Genetic Polymorphism in Domestic Animals.

An ecological information system with several stations has been developed for monitoring the pollution from the Šoštanj power plant; the station in Zavodenj is shown.

ECOLOGY

The comprehensive national programme has been established to address the immediate goals of this multidisciplinary area: physicists, chemists, biochemists, biologists, physicians, mathematicians, architects and many others are involved in research, development and application problems, education, communication, informations systems and other activities to save and protect the environment. Although scattered over various institutions, these projects will be coordinated in the Institute for Environment (in planning). These projects and institutions are connected through various contracts and common research programmes. The major tasks of the National Environmental Programme are:

- development of analytic methods for monitoring pollutants in the environment, food, biologic samples, etc. In addition, validation of test sytems, quality of control, and data bases should be provided,
- monitoring the fate of pollutants' distribution, including the measurements, research of transport, transformation and kinetics of distribution in the natural environment and in experimental models,
- assessment of risk for certain pollutants and studies of its effects on man, animals and plants,
- development of prevention and sanation programmes.

Environmental impact assessment group - SEPO

SEPO is a multidisciplinary group for the evaluation of environmental impacts and was established in 1974 on the initiative of the J. Stefan Institute in order to perform complete scientific and interdisciplinary evaluations of the environmental effects of any planned investment or reconstruction (EIA, EIS - Environmental Impact Assessment, Environmental Impact Statement).

Department for Environmental Impact Assessment - SEPO
Head:
MSc. Svetozar Polič
Address:
J. Stefan Institute,
Jamova 39, Ljubljana
Tel 38-61-159-199,
Fax 38-61-161-029

In addition to the scientists and laboratories at the Jožef Stefan Institute, several professional institutes and faculties are engaged in the SEPO programme. This means that experts from different fields of environmental research such as chemists, biologists, meteorologists, technologists, mechanical engineers, hydrolo-gists, architects and others are included, depending on the nature of the proposed investment.

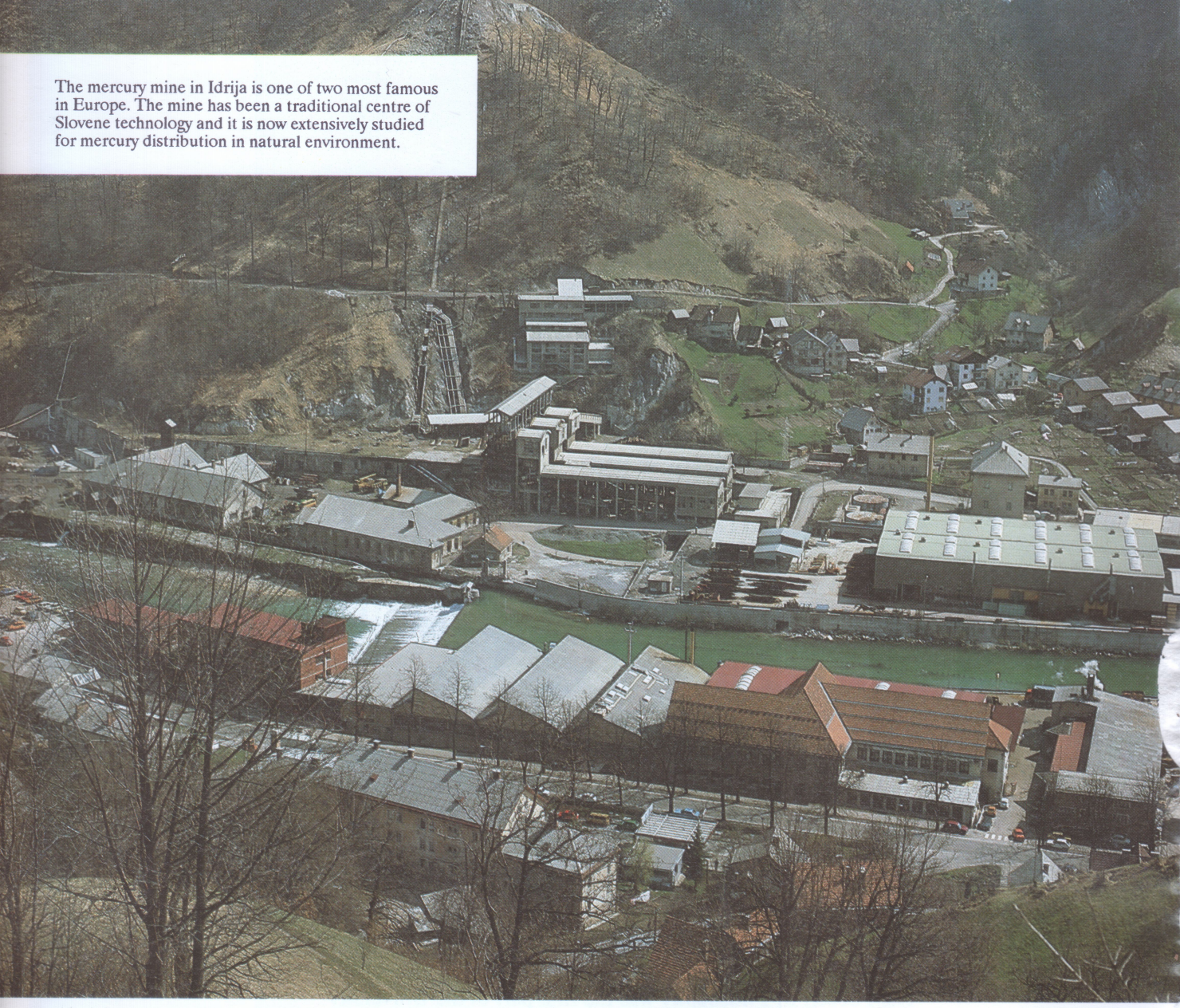
Up to now, about 550 environmental impact reports on a wide range of new investments (chemical and pharmaceutical plants, metallurgy, paper and pulp mills, food and agricultural investments, a uranium mill, a nuclear power plant etc.) have been made. Through requirements and recommendations in these environmental impact assessments (considering the legislation and official regulations), SEPO tries to prevent and/or minimize the harmful effects on the environment of each particular investment.

THE HUMANITIES AND THE SOCIAL SCIENCES

Faculty of Philosophy
Dean:
Prof. Dr. Marko Kerševan
Address: Aškerčeva 12
61000 Ljubljana
Tel.: 38-61 150-001
Fax: 38-61 159-337

The ***Faculty of Philosophy*** was the first part of the University of Ljubljana to be established, in 1919; since then the humanities have been sharing the developments of most of the disciplines at a steady academic level, occasionally breaking through into the front-line of theoretical progress, above all in Slavic philology, History of art, History and Comparative Literature. After a series of revolutions in particular disciplines over the past two decades, the humanities are now working towards a new unity of their fields along the lines of a wholistic anthropological approach, combining standard research techniques with more recent strategies for the analysis of institutions, discourse analysis, "marginalist" historiography, history of mentalities etc.

In ***Ethnology***, a radical shift towards investigating the "modes of everyday life" (Vekoslav Kremenšek and his students) has produced some fine research on urban and working-class ethnology (V. Kremenšek); on the ethnology of poor suburban agglomerations (Mojca Ravnik); on the ethnology of the concentration camps during World War II (Božidar Jezernik); on the culture of the Slovene emigration (Janez Bogataj, Breda Čebulj-Sajko,



The mercury mine in Idrija is one of two most famous in Europe. The mine has been a traditional centre of Slovene technology and it is now extensively studied for mercury distribution in natural environment.

Zmago Šmitek). Interesting research is also being carried out by B. Jezernik in political anthropology, by Ingrid Slavec in linguistic anthropology, and by Daša Hribar on ethnic identity.

Remarkable progress has been made in ***Archaeology***: the introduction of holistic multi-disciplinary field research has both produced important new knowledge about Slovenia and stimulated epistemological discussion of large and general interest, esp. for the connecting disciplines of anthropology, historiography, ecology, ancient economy etc.

Amongst the diverse studies in the programme of the Department of ***History***, we can mention only some of the most interesting: the influence of the Aquilean patriarchy on early Christianity in the Balkans, Pannonia and the Eastern Alps (Rajko Bratož); the political and mercantile relations between Istria and Venice (Janez Peršič); the defense against the Turkish in-

cursions and cultural activity in Slovenia (Ignacij Voje); social groups in the 17th century - studies based on the Statutes of the town of Moščenice - (Vasko Simoniti); military organization in Slovenia during the 16th and 17th centuries (Vasko Simoniti); the everyday life and mentality of the Carniolan nobility, 15th-18th centuries (Maja Žvanut); the material culture of the Carniolan nobility, 17th-18th centuries (Marko Štuhec); trade unions in Slovenia up to 1941 (Miroslav Stiplovšek); parliamentary elections in Yugoslavia 1920-1938 (Bojan Balkovec); Yugoslavia and the Cold War 1945-1955 (Dušan Nećak); the position and function of non-slavic languages in Slovenia from 1850 onwards (Albina Nećak-Lük).

Faculty of Social Sciences
Dean:
Prof. Dr. Slavko Splihal
Address:
Kardeljeva ploščad 5
Tel.: 38-61 181-461
Fax: 38-61 341-522

The ***Social Sciences***, which developed out of the humanities carry out the empirical work, most noteworthy being the annual extensive inquiry into public opinion in Slovenia (Niko Toš and his team). The original Department of Sociology at the Faculty of Philosophy, the first of its kind to be founded in Yugoslavia, specialized in the analysis of ideology (Marko Kerševan, Rastko Močnik), and has worked out historical analyses of the school-system (Bojan Baskar, Mirjam Milharčič-Hladnik), of the formation of nations and of contemporary ethno-nationalism (Rudolf Rizman). It has also an anthropological theory of contemporary ethno-nationalism (Rastko Močnik); a Socio-historical elaboration of the labour movement (Marjan Britovšek, Lešnik); and an analysis of the ideologies of urbanism and architecture (Braco Rotar, Evros Alexandrou). Recent developments in archaeology have stimulated research on anthropological analogies in archaeology, the project on the definition of sexual division in anthropology and prehistories and the research of the productive impact of the material culture on the formation of cultural concepts (Iztok Saksida). This work was done in collaboration with the Department of Archaeology (Božidar Slapšak).

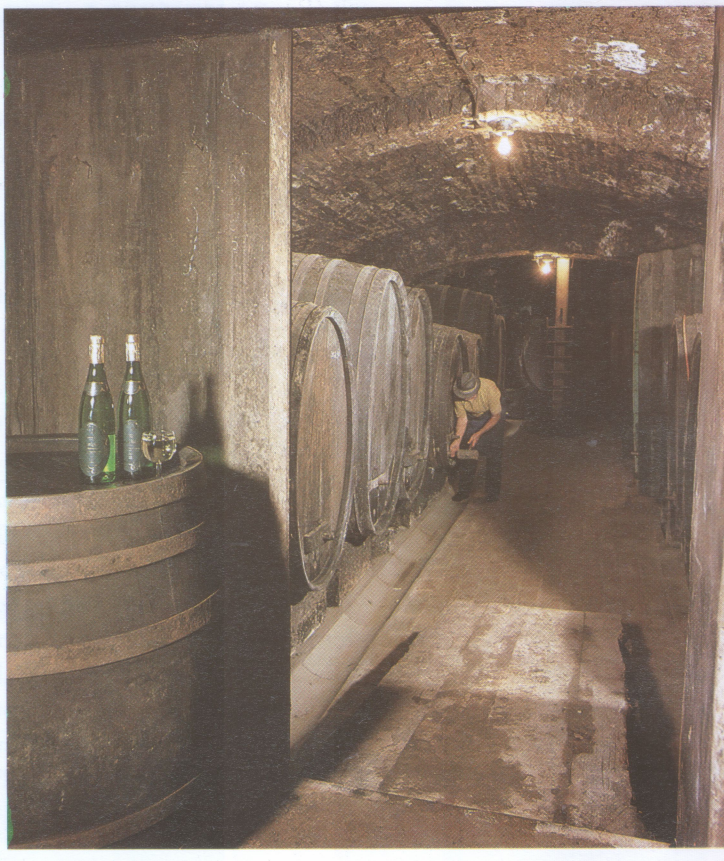
Over the past fifteen years, an inter-disciplinary study project (Mladen Dolar of the Department of ***Philosophy***, Rastko Močnik of the Department of ***Sociology***, and Slavoj Žižek of the Institute of Sociology) has developed a complex historical and structural analysis of different types of "totalitarianism" (fascism, Stalinism, "self-management"), critically combining the analytical strategies of Althusserian historical materialism, Lacanian psychoanalysis, the Frankfurt School, and different types of discourse-analysis of ideological mechanisms. A complementary study of Stalinism has been proposed by Tomaž Mastnak of the Institute for Philosophical Research at the Slovene Academy of Sciences and Arts. The same group has also proposed several rather critical insights into the theory of civil society. The epistemological problematies of both the humanities and the social sciences have been a constant concern, particularly elaborated along the lines of materialist epistemology at the Institute for Philosophical

Research (Rado Rihar, Vojo Likar), and in the style of analytic philosophy at the Department of Philosophy of the Faculty of Philosophy (Andrej Ule, Nenad Miščević, Matjaž Potrč). A reconstruction of the humanities and social sciences, reformulating the tradition of the "studia humanitatis", is being elaborated at the Department of Sociology, Faculty of Philosophy, by Rastko Močnik and his colleagues. Connected to this is the series Studia Humanitatis (published by the Faculty of Philosophy and the Student Cultural center), including translations of the classical and/or crucial texts of the 20th century, presented by outstanding specialists and articulated towards the current issues.

At the Institute of ***Education*** a group of researchers (Marjan Šetinc, Barbara Japelj, Ana Gradišar and a team of outside experts) is working on several studies under the auspices of the "International Association for the Evaluation of Educational Achievement" (Third Interrational Mathematics and Science Study, Computers in Education, Reading Literacy, Moral Values) as well as on the project "International Assessment of Educational Progress". Other groups working at the Institute are: first, a group (led by Eva Bahovec and Zdenko Kodelja) on fundamental research concerning the history and present dilemmas of the educational apparatus, the ambiguous role of historical and contemporary, educational ideologies, contradictions within the school-system as an instrument both for the transmission of knowledge and for the reproduction of the social relations of domination, the function of authority in the institutional couple school-family, etc; second, a group (led by Darja Piciga and Dora Gobec), working on the problems of child development, implementation of developmental findings to educational practice, on the structure and inovation of learning processes; and third, a group (led by Zoran Jelenc) covering the problems of adult education. There is also a group (led by Darko Štrajn and Olga Gnamuš) concerned with linguistic and communicational problems of the educational process. Some of the members of these groups edit the international journal "The School Field".

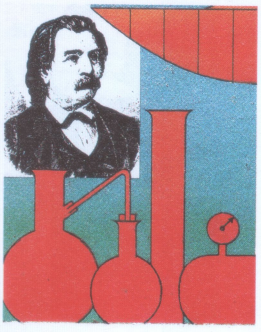
There is also a body of researeches which has no particular institutional affiliation; this is the sophisticated group gathered around the journal Ekran (Zdenko Vrdlovec, Silvan Furlan, Majda Širca, Bogdan Lešnik) who, over the past fifteen years, have developed a top-ranking school of ***Film Theory***; the journal holds an annual international School of Film Theory, publishes widely, and occasionally organizes specialized film festivals in Ljubljana, International annual colloquia are also held by the Society of Aesthetics which produces relevant and up-to-date ***Aesthetic Theory*** (Aleš Erjavec, Lev Kreft).

The oldest living vine in the world has been planted in Maribor over 400 years ago. The research in enology and food technology at both Slovenian universities has greatly improved the quality of agriculture products.



In the areas of ***Social Psychology, Criminology and Social Work***, a network of several groups (Vito Flaker) is engaged in the critique of normalization, encouraging processes of de-institutionalization and creating alternative projects of "mental health". An important theoretical critique of psychiatry and other repressive institutions, analyzing their historical articulations and actual transformations, accompanies these practical projects. Through a number of action research projects authentic experiences have been generated in the fields of social work, community mental health, juvenile delinquency, voluntary work and intermediate structures in order to promote non-reductionist anthropologically-based approaches to psycho-social work and treatment.

INTERNATIONAL LINKS



There is a broad network of collaboration partially with the neighbouring countries, but mostly with the highly developed countries in Europe, such as the Federal Republic of Germany and with the United States of America. Most collaborations are in various technical fields and in medicine. Besides, there are a few projects, mostly from industry, carried out in collaboration with the former Eastern European Countries and the USSR.

International European organizations, supporting various projects:

COMECON - Council for Mutual Economic Assistance
EC - European Community (COST, TEMPUS, EUREKA)
OECD - Organization for Economic Cooperation and Development
IAEA - International Atomic Energy Agency
IOS - International Organization of Standards
UNESCO - United Nations Educational, Scientific and Cultural Organization
UNFPA - United Nations Fund for Population Activities
UNIDO - United Nations Industrial Development Organization
UNDP - United Nations Development Program
WHO - World Health Organization

Non-European Countries: United States of America (USA)

There are numerous US Agencies, supporting the research in Slovenia with different types of grants:

- Bureau of Mines (BuMi)
- Department of Energy
- US Department of Transportation (DOE)
- Department of Health and Human Services (DHHS)
- National Institute of Disability and Rehabilitation Research, NIDRR.
- National Institute of Standards and Technology (NBS)
- National Science Foundation (NSF)
- US Department of Agriculture (USDA)
- US Geological Survey (USGS)

Among several other countries, **Scientific cooperation with Japan** deserves special mention. Yugoslavia, as a whole, and consequently Slovenia, has not optimaly benefitted from official channels for scientific cooperation in the past. Nevertheless, numerous connections have been established between Japanese and Slovenian scientists. Only some of the areas and institutions are listed below:

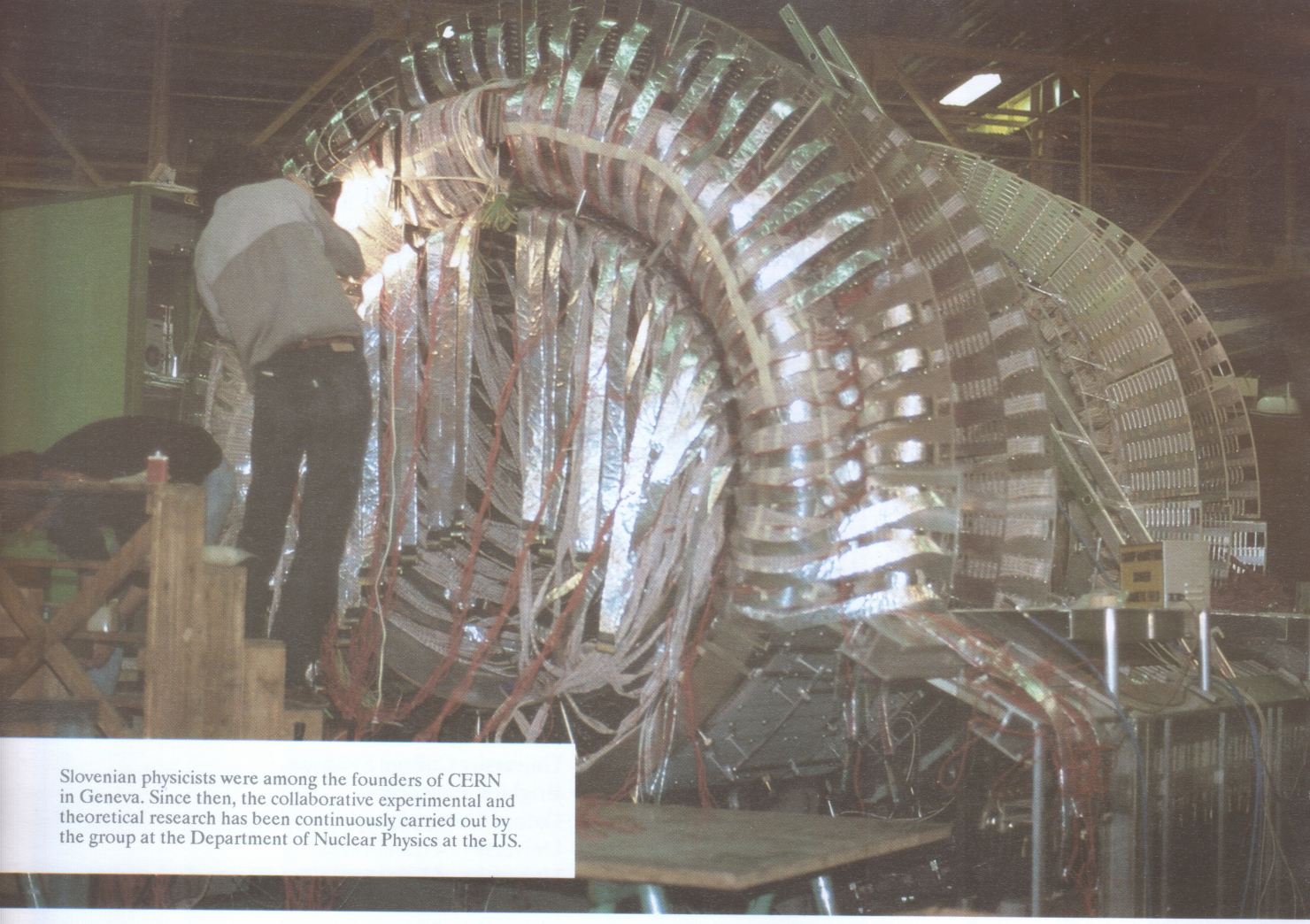
- Physics-ferroelectric materials (IJS) - Waseda University,
- Flow dynamics (Faculty of Mechanical Engineering) - Kyoto University,
- Agriculture and biotechnology (Biotechnical Faculty, UL) - University of Miyazaki

European Countries:

Research links have been established with the neighbouring countries - Austria, Italy and Hungary - as well as with other European countries from the Netherlands to the Soviet Union. Some examples of the most successful collaboration are listed below:

COUNTRY	Research AREA	INSTITUTION
France: 7 projects	Organic chemistry	Univ. of Rennes
	Microsurgery	Hôp. Montpellier
	Genetics	Hôp. Paris
	Pediatrics	Hôp. R.Debree
	Cardiology	Hôp. J.Rostand, IYRY- Paris
	Cattle-breeding	I.N. de la Recherche Lille
Great Britain:	Mathematics	University of Cambridge
12 projects	Chemistry	Leicester University
	Fluorichemistry	Leicester University
	Biochemistry	University of Newcastle
	Artificial intelligence	The Turing Institute
	Natural sciences	University College Swansea
	Civil engineering	Brighton Polytechnic
	Electronic engineering	Oxford University
	Biotechnology	University of Cambridge
	Veterenary	University of Liverpool
	Cattle-breeding	The Rowett.Inst.Aberdeen
	Cattle-breeding	University of Liverpool
Federal Republic		
Germany: 20 projects	Chemistry	University Claustral
	Materials testing	BM., Berlin
	Physics	DESY Center, Hamburg
	Physics	CERN, Geneva
	Physics	KFZ, Karlsruhe
	Radiochemistry	KFA Julich
	Chemistry	KFA, Julich,
	Chemistry	KFZ and University, Karlsruhe
	Technical sciences	KOMEG, Riegelsberg
	Engineering	KFA, Julich
	Civil engineering	Techical School, Graz
	Electrical engineering	Technical School, Graz
	Physics	Max Planck Inst. Heidelberg
	Physics	University Mainz
	Biochemistry	University Clinic, Munich
	Molecular biology	Technical School, Munich
	Physics	Institute Berlin
	Geology	KFA Jülich
	Wood sciences	Technical University Munich

Out of these projects on the Slovenian side: ~27 % research groups are from the Institute Jožef Stefan, 2% from the Institute Boris Kidrič, 4% from the Institute for Testing and Research Materials and Structures, 44% from the University of Ljubljana (Medical Faculty 8%, Biotechnical Faculty 16%, FNT 16%) and the University of Maribor and 16% from industry research institutions.



Slovenian physicists were among the founders of CERN in Geneva. Since then, the collaborative experimental and theoretical research has been continuously carried out by the group at the Department of Nuclear Physics at the IJS.

Most **USA scientific exchange** support is in the field of the natural sciences, medicine and biotechnology, as represented in the following Table:

Technical Sciences Technology	Natural Sciences	Medicine	Biotechnology and Biology
Mining, Geolgy (2)*			
Civil Engineering (4)			
New Technologies (4)			
Construction Materials (5)			
Electronic Engineering (2)			
Machine Engineering (1)			
Metallurgy (1)			
	Chemistry (17)		
	Physics (12)		
		Electro-medicine (4)	
		Medicine (5)	
			Biotechnology and Agriculture (11)
			Biotechnology (3)

* total number of projects

The Ministry of Science and Technology has in 1991 started annually awarding the honorary title of "***The Ambassador of the Republic of Slovenia in Science***" to distinguished scientists working on Slovenia, who had in the previous years achieved high international recognition of their work, especially outside the narrow professional circles. Excellence of a candidate is judged by:

- international awards to the nominee,
- books he/she has authored and which have found recognition abroad,
- invited lectures at prominent institutions,
- membership in most prominent international scientific societies,
- taking part in major international projects.

Part of the award is a monetary fund intended for financing the research of the nominee and his/her research group:

In 1991, the prize winners were:

Adacemcian Robert Blinc - Solid State Physiscs
Prof. Dr. Ivan Bratko - Artificial Intelligence,
Prof. Dr. Vinko Dolenc - Neurosurgery,
Prof. Dr. Aleksandra Kornhauser - Chemical Education and Informatics,
Prof. Dr. Dušan Mlinšek - Forest Management,
Prof. Dr. Slavoj Žižek - Philosophy.

Some of the outstanding collaborations of general national interest: IJS and International Atomic Energy Agency (IAEA)

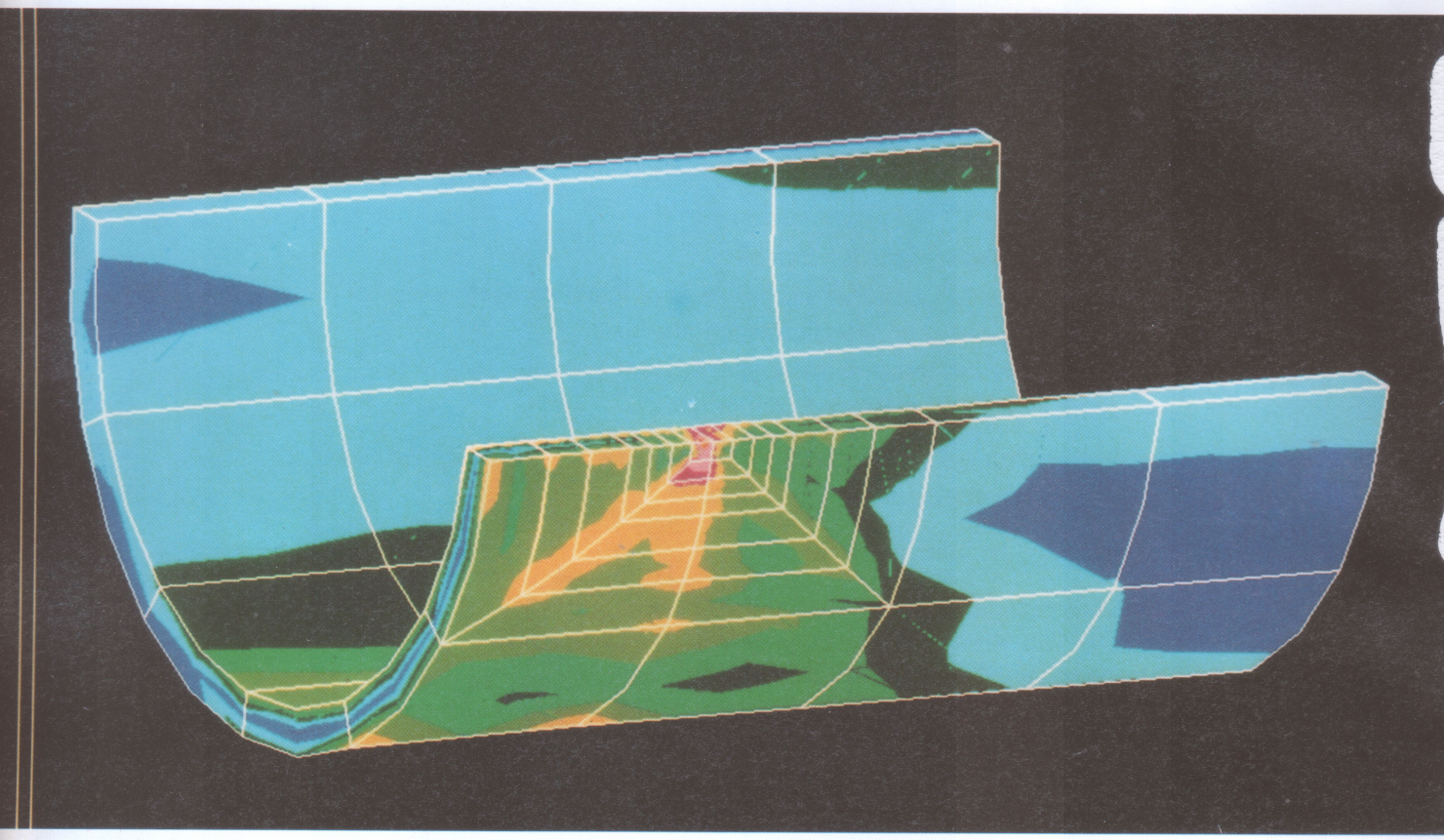
Since the beginning of the national nuclear energy programme, International Atomic Energy Agency (IAEA) has been very interested in cooperation with Slovene institutions in this field. The Jožef Stefan Institute was and still is its main partner in the area of nuclear safety and radiation protection. The cooperation has been evolving in different areas:

In the first years after the start of the nuclear programme, the main IAEA cooperation was in the form of Technical Assistance (TA) Programmes. A programme normally offers three types of IAEA Cooperation with the participating institutions. IJS experts have also been involved in similar projects in other developing countries. Generally, they have spent a month in the foreign country, transferring their knowledge to local scientists.

In the early years of IJS activity in nuclear safety, when domestic computing capabilities were not yet available, IAEA offered its computing capabilities in the Vienna International Centre for safety analyses, performed by the staff of IJS:

- supporting research activities in member states through ***Research Contracts***. IJS has participated in several such contracts in the recent years,

Research done by the Reactor Engineering Department at IJS in the field of structural analysis is represented by computer aided tube crack opening analysis by the finite element method.

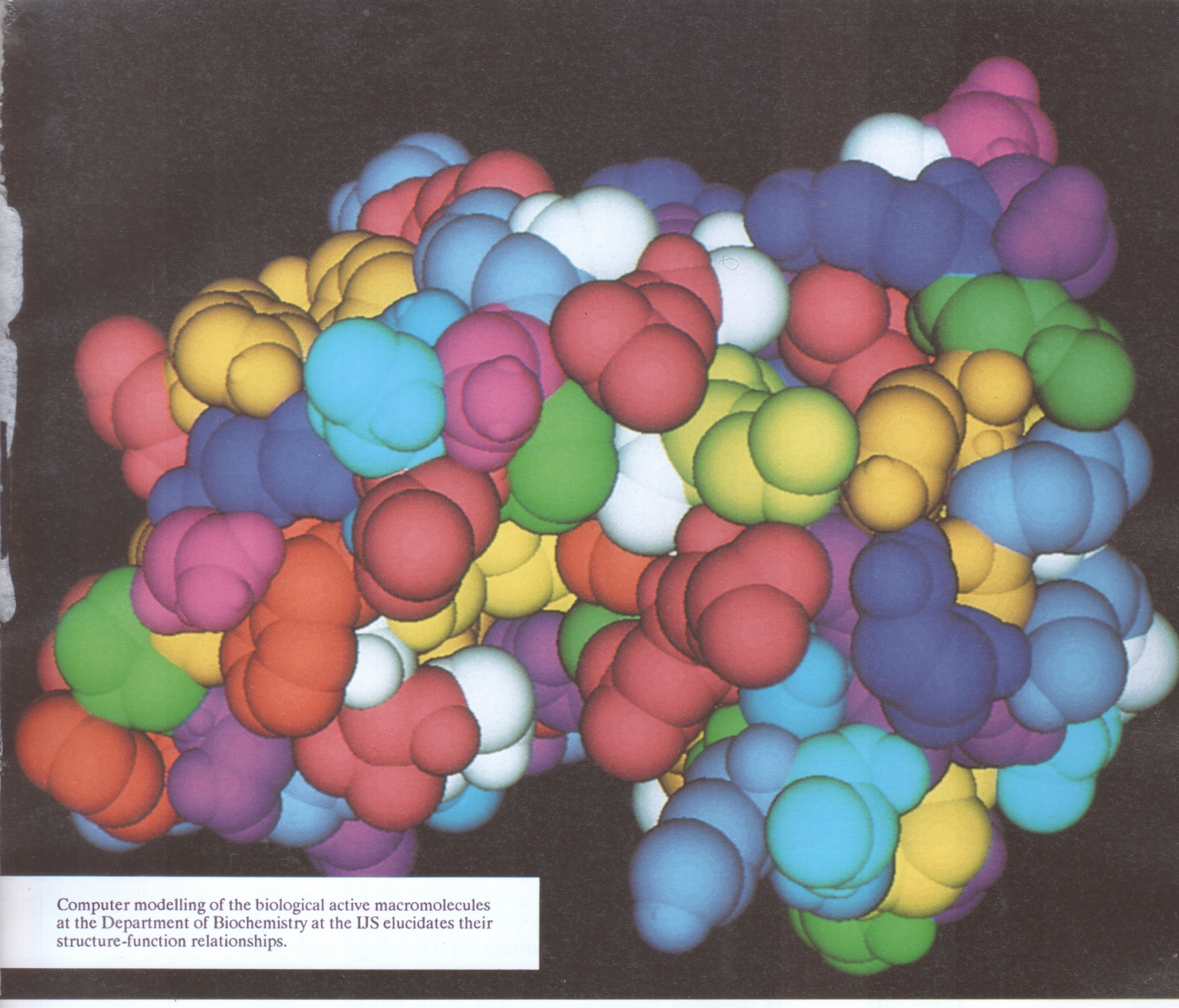


- has organized several ***Standard Problem Exercises***, in which IJS has actively participated. Standard problems are experiments at a chosen test facility, which can give relevant data for improvement of overall knowledge in the field of thermal-hydraulics,
- regularly organizing ***Technical Meetings***, covering practically all topics related to nuclear energy,
- organizing ***Expert Missions*** to selected nuclear facilities in different countries, for checking the safety of their installations. Such a mission is composed of top experts from several developed countries who normally stay at the chosen facility for several weeks,
- maintaining a large data base in the field of nuclear energy called INIS. IJS is actively participating in its use and updating.

Department of Biochemistry IJS - UNESCO Institute

IJS - Department of Biochemistry
Head:Prof.Dr. Vito Turk
Research Staff: 33

The Department of Biochemistry and Molecular Biology was selected to be one of the 50 laboratories in the world, forming a network for cell and molecular biology. This network was launched by the Director General of UNESCO in 1990. Members of this network include, the Institute Pasteur, France, the Max Planck Institute of Biochemistry, Germany, NIH-Bethesa, Berkley, California, etc.



Computer modelling of the biological active macromolecules at the Department of Biochemistry at the IJS elucidates their structure-function relationships.

The main field of investigation of the IJS group is the ***Biochemistry of Proteins***. The complex scheme of this research includes the isolation of proteins from various natural sources, investigations of their biochemical properties, studies of their physiologic properties and elucidating their primary and tertiary structure. The proteins, natural and recombinant forms, obtained with gene technology, are cloned in microorganisms and isolated as described above. Natural and new proteins could be applied to various industries and to medicine.

Of special interest are the hydrolytic enzymes, in particular ***Proteinases and their Endogenous Inhibitors***. The research is focused on cellular proteinases of human origin (named cathepsins) and their protein inhibitors (named cystatins). The natural inhibitors would be useful in prevention and therapy, and clinical investigations of these substances are carried out in

Information methods in chemical education, research, technology development, and ecology are developed at the Department for Chemical Education and Informatics of the University of Ljubljana.

collaboration with the Clinical Centre, Institute of Oncology and other hospitals in Ljubljana and abroad. The studies of the molecular structure of these substances are therefore absolutely required at all levels: the group was not only the first to sequence a number of cathepsins, cystatins and phospholipases, but also discovered new inhibitors and enzymes like stefins (named after the J. Stefan Institute), cathelin, cathepsin S, etc. In collaboration with the crystallography group at the Max Planck Institute, various crystal structures of proteins were revealed. Recently developed methods of genetic engineering have given fresh impetus to the research programme: genes for human stefins A and B was cloned and expressed. Experiments on site directed mutagenesis are performed in order to determine the mechanisms of inhibitory activity of these substances.

Neurotoxic phosphalipases - another field of research being ***Toxicology*** - were also cloned and molecular changes are carried out in order to elucidate the mechanism of their toxicity.

Immunology is also one of the research fields with a strong tendency for its application in clinical use: the Tissue Culture Laboratory was established recently and the development of commercially interesting preparation of monoclonal antibodies is in progress.

UNESCO International Centre for Chemical Studies in Ljubljana at the Faculty of Science and Technology, Ljubljana University

Head:
Prof. Dr. Aleksandra Kornhauser
Address: Vegova 1, 61000 Ljuljana.
Tel.: 38-61 214-326
Fax: 38-61 226-1760

Activities within the framework of the UNESCO International Centre for Chemical Studies started with organizing international schools in 1976 under the auspices of UNESCO. In 1980 the UNESCO General Conference approved the programme and the Centre was given a coordinating function for the International Network for Chemical Education. This function was extended to include chemical informatics in 1989. As of 1990, 43 international post-graduate seminars and expert meetings were organized with more than 3000 participants from 78 countries. These meetings were supported by UNESCO, UNIDO, UNDP and The World Bank. The Centre publishes special series in this field, as well as the UNESCO Courier.

International research projects include building information systems for the control, processing and minimization of hazardous waste generation (e.g. INTERNET - ten countries involved), and development of speciality chemicals produced by chemical or biochemical processes (e.g. BITES - all European countries involved). The Centre supports university/industry projects (Africa, Asia), in which it has an international coordinating function. Bilateral projects are taking place in cooperation with Italy and the United States, and international projects with UNESCO, UNIDO, UNDP and The World Bank.

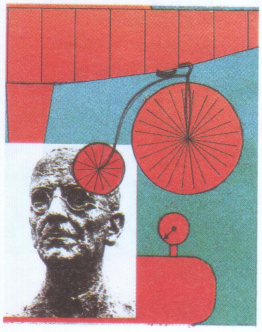
In cooperation with 13 industries, an information system for the production of speciality chemicals, produced by chemical and biotechnological processes, was established. In selected branches it is highly specialized and supports the introduction of new products and technologies, especially new special polymers, biodegradable pesticides, natural products for pharmaceutical and food industry, microencapsulation technology, and management of hazardous waste.

Information methodology includes:

- defining and informatization of research, development and education problems,
- developing techniques for collection, sorting and processing of data,
- developing methods of structuring data into systems, knowledge patterns (matrixes) recognition and setting hypotheses,
- implementing laboratory ard pilot-scale testing of such hypotheses,
- introducing information methodology into education.

At the undergraduate level, and the post-graduate levels, there are educational programmes of chemistry education methodology and chemical informatics, supported by international cooperation, as well as specialized courses for chemical industry.

RESEARCH FACILITIES AND INFORMATION SYSTEMS



RESEARCH EQUIPMENT

Major Research Equipment and Facilities located at various institutions in Slovenia:

- Van de Graff accelerator (2 MeV),
- TRIGA research reactor (250 kW),
- Low and high resolution mass spectrometers,
- NMR spectrometers (high resolution, double resonance),
- NMR tomograph,
- Electron microanalyzer,
- Time of flight spectrometer,
- Thermal and X-ray spectrometers,
- Preparative ultracentrifuges,
- Various liquid and gas chromatographs,
- Protein sequenators,
- DNA synthesizers
- Recombinant DNA facilities,
- Several TEM and SEM electron microscopes,
- Equipment and facilities for developing microelectronic, devices and technologies,
- CAD systems for mechanical and civil engineering,
- Computer networks,
- Computer systems: DEC VAX 8000 and 8650 and Convex 220-128 E,
- Facilities for research of seizmic strength of structures.

INFORMATION SUPPORT FOR EDUCATION AND SCIENCE

Computer Support

It is a longtime tradition in Slovenia to provide the research community with relatively powerful computing support. Already in 1972 a large CDC CYBER 72 had been installed. There are two clusters of two DEC VAX 8000 computers at each of the computing centers of the Ljubljana and Maribor Universities, and aDEC VAX 8650 at the IJS. In addition to those computing and communication focal points at the three computing centres, many smaller DEC machines have been installed.

But obviously, this is not enough for all areas of research. The need for HPC (High Performance Computing) support of scientific research has been recognized (by some of our R&D groups) for quite some time. The funding was approved in 1989, and a Convex C220-128E was installed at the Jožef Stefan Institute in January 1990.

Subsequent work done on the C220 mini-supercomputer not only proved that the investment was fully justified and that the participating research groups were more than capable of taking full advantage of the computing resources available. A new initiative was launched in 1990 with the goal: establishment of a National Supercomputer Centre.

The High Performance Computing Initiative of The Ministry of Science and Technology of Republic of Slovenia

The Ministry of Science and Technology of the Republic of Slovenia sees HPC as a crucial element of future science and technology - in view of the large investments that developed countries are making into HPC, the future competitive ability of both our science and industry may well depend on our ability to employ supercomputer-supported compute-intensive R&D tools. In recognition of these facts, The Ministry is launching a wide-scope HPC initiative based on the following premises:

- the global trend towards HPC - based R&D requires government - sponsored actions to assure that both Slovene science and industry will be able to compete in the future world;
- some R&D groups have already achieved proficiency with HPC techniques;
- both the HPC equipment and the HPC-related R&D will provide an immediately applicable base for industrial R&D;
- the National Supercomputer Centre will be established within the next 12 months - 1 GFLOPS moderately-parallel vector supercomputer.

Networking activities

Such an extensive computing support service could not become effective without appropriate networking support.

The internetworking is, at present, mainly provided by the proprietary DECNET-based Slovenian network with more than 200 nodes. A high speed wide - area network for internetworking purposes is badly missing, even if the Slovenian X.25 Packet Switching Network (a public network) caters for some more moderate requirements. Provision of a high-speed, wide - area network is a part of the HPC strategy.

International connectivity is provided by different means: either using standard OSI based protocols, or by use of EARN/BITNET protocols. Participation of Slovenian institutions in the EUREKA Project COSINE (Cooperation in Open System Interconnection Networking in Europe) provided considerable experience. The J. Stefan Institute is operating the Well-known Entry Point for X.400 mail for all Yugoslavia, with a traffic of approximately 40,000 messages per month by the end of 1990, with an average monthly growth of more than 10 %. Access to the International X.25 Infrastructure network (IXI), which is an operational result of the COSINE project, provides medium speed (64 kb/s) communications with the majority of European Research Networks. Connection to Internet is planned for the end of 1991.

Closely connected with the networking capabilities is the provision of the information services (databases)by the University computing centre of the Maribor University which has been designated as primarily responsible for the System of Scientific and Technical Informations, providing some of the more widely used technical and scientific databases and collecting library information for the Republic of Slovenia. The same service is supplied, at present, for the whole Yugoslav research community.

Science Libraries

All research institutions have their own libraries, which are open to the public. There are also several libraries of national prominence: the National and University Library (NUK) and The Central Technical Library are located near the University of Ljubljana. The former has a tradition of more than 200 years, ranking among the 300 biggest libraries in the world due to its impressive fund of over one million volumes. With about 3,000 rare manuscript, it shelters an important part of the Slovene cultural heritage. Furthermore, it has over 180,000 maps, graphics, picture postcards, about 70,000 musical documents, records and cassettes. The Maribor University Library is part of a large international library system.

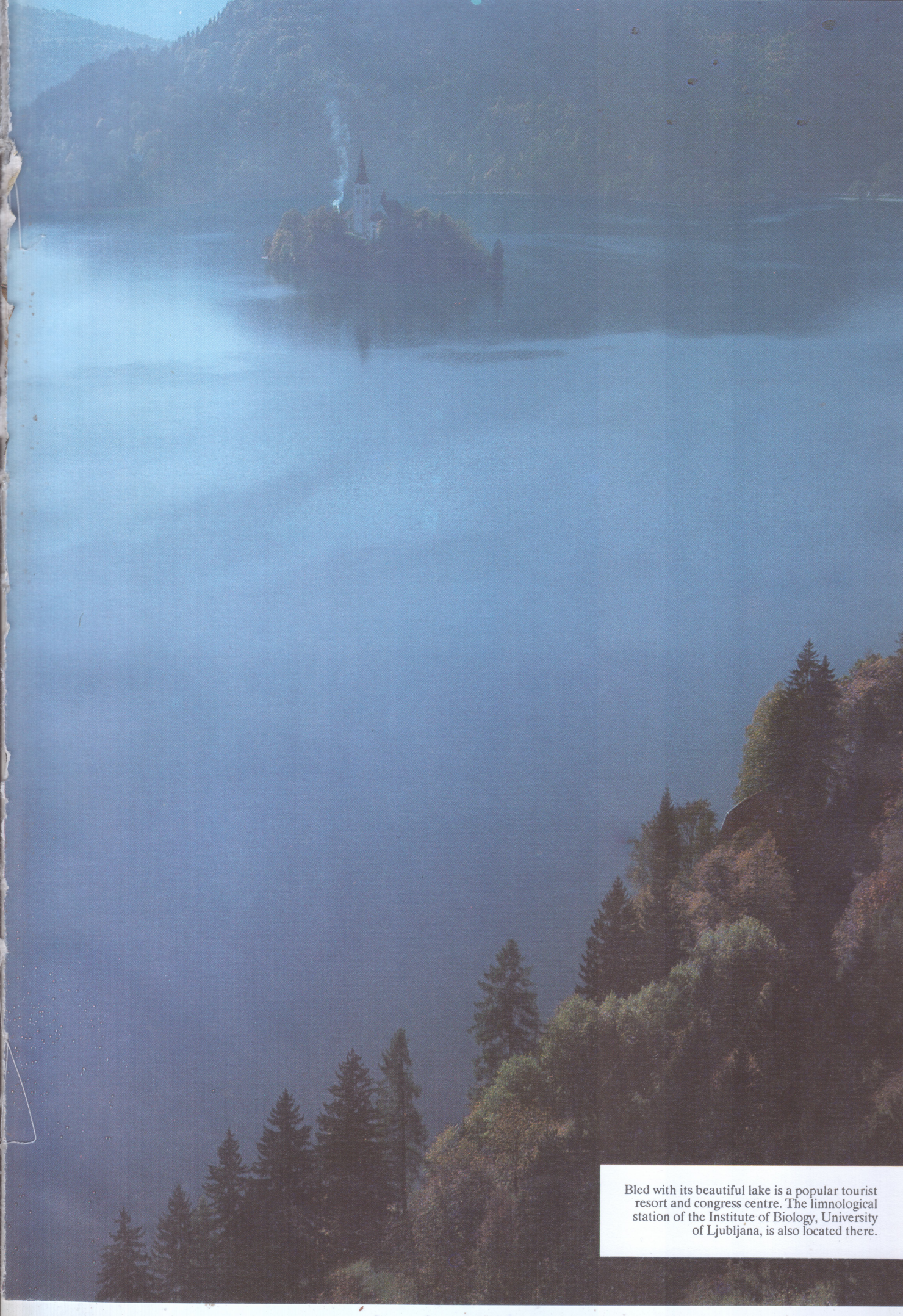
CONGRESS FACILITIES

Ljubljana is situated in the heart of Europe and has a perfect position for meetings of politicians, business people and scientists. The city has a long congress tradition, which started with an unique historic event: In 1812 it was host to the first "real" congress in the world - The Holy Alliance.

Today, congress activities are centered at Cankarjev Dom, a multipurpose congress and cultural center, which has modern facilities, equipment and services. It offers twelve auditoriums, which can accommodate 5,000 visitors at a time. It attracts over 25 events annually, in the fields of culture, science, exhibitions, theater, etc. Among the more prominent international meetings held recently in Ljubljana, have been:

- 17th World Design ICSID (postponed)
- 2nd European Congress of Endocrinology
- 11th International Congress on Thrombosis
- International Meeting in Advances in Robot Kinematics
- International Conference on Hydraulic Machinery
- 18th Federation of European Biochemical Societies Meeting
- 18th Intl. Union of Forestry Research Organization
- MELECON 91 - Mediterranean Electrotechnical Conference

There are also other attractive locations in Slovenia, such as Bled, Portorož and Radenci - where numerous meetings have already taken place over the past decades.



Bled with its beautiful lake is a popular tourist resort and congress centre. The limnological station of the Institute of Biology, University of Ljubljana, is also located there.

Footnote by the Editors:

The perspective of science in Slovenia presented in this volume is not covering all research activities in the country. Although the selected research groups are distingnished by a continuous organized research over last few years, high rate and quality of publishing as well as other kinds of internationally recognized scientific achievements, due to the limitation in space, there is a number of excellent scientists and research teams whose names were not mentioned here and/or would their works deserve more detailed description. A more extensive volume of the scientific endeavours in Slovenia is in preparation.

***

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